MARINE REVIEW.

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Vessel Owners Who Control Lake Shipping.

With this issue, the REVIEW presents to its readers, in the form of a double-page, photogravure supplement, a collection of portraits of officers and managers of the Lake Carriers' Association. Our readers will undoubtedly bear us out in offering no apology for the portraits, as the likenesses are in every case an exact reproduction of the best photographs it was possible to secure. Probably in no other way, excepting the plan pursued by the REVIEW, could such a picture be secured. In many cases several letters of a pleading and partly persuasive kind were required before photographs were obtained, and this was in itself no small part of the work that resulted in practically all of the managers of the association being represented in a group that could not otherwise be gotten together. A picture historical of the association is thus obtained through one of the many advances that have of late been made in the art of engraving. Only in two or three instances, where photographs represent members a little younger than they are at present, is there any difference, as regards likenesses, in this picture and one general photograph that might be taken with all present.

Better than any history that might be written of this organization is the picture of its managers here shown. Although a large portion of the lake fleet is not included in the association, on account of the tonnage dues connected with the maintenance of shipping offices, from which all vessels do not receive benefits alike, there is at the present time a membership controlling more than 650,000 registered tons. This means, of course, the tonnage of the vessels as fixed by the customs department of the government, and not their carrying capacity, which would probably be greater than 1,000,000 tons.

In matters pertaining to shipping legislation, in the promotion of river and harbor improvements, and, in fact, in all things pertaining to the conduct of the shipping business on the lakes, excepting the regulation of freights, this organization has for several years been an important power. The officers are continually in correspondence with members of congress and various heads of departments that have to do with marine matters. On all occasions where the interests of the association demand it, representatives are sent to Washington direct, and the government officers in this country, as well as Canada, look to this body as the representative organization of the lakes. The association had a modest beginning. Only a few years ago H. M. Hanna, Capt. Geo. P. McKay, and a few other Cleveland vessel owners, whose portraits appear in the picture, organized the Cleveland Vessel Owners Association, which was, by good management, made to prosper after hard work. About the same time, or a little later, the vessel owners of Buffalo organized what was known as the old Lake Carriers' Association. Both organizations were limited in membership and in some matters were in conflict, until the winter of 1891-92, when a movement was begun in Cleveland by Messrs M. A. Bradley, Thomas Wilson, James Corrigan and others for a consolidation. Owners in Buffalo as well as other leading ports joined in the movement, and the consolidation was effected. Mr. Hanna had dropped out of active work among the vessel owners, and the three other gentlemen named as promoters of the consolidation have since been elected in turn to the presidency of the new organization, the by-laws of which provide that a president shall serve but one year. Capt. McKay, who was secretary of the Cleveland association, and to whom credit was largely due for its success, has held the position of treasurer in the new body since its organization, while Mr. C. H. Keep of Buffalo, who was secretary of the old Lake Carriers' Association, occupies the same position in the present organization.

Double Number of the Review.

A ship built exclusively for passengers, costing as much, if not more, than any merchant vessel ever built in this country, and representing in construction of engines and boilers the highest practice known to ship building throughout the world, has just been placed in service on the lakes, and in view of the importance of all matters pertaining to such a vessel, the REVIEW devotes a great deal of space in this issue, which is more than double the usual size, to engravings and a description of all parts of the boat. By the use of photographs taken during the various stages of construction, and through the assistance of the builders and owners, as well as the principals in charge of different parts of the work, a complete and reliable description of the steamer North West is presented in a form that will permit of it being preserved for future reference.

Although this issue, with two large double-page engravings of the boat, engines and boilers will be mailed to all regular subscribers, the great cost attached to it will not permit of general distribution at the regular price for single copies. A large supply of extra copies has been printed and they may be secured at 50 cents each. Special rates will be made to agents.

Raft Towing at the Head of Lake Superior.

In advance of the river and harbor bill being considered in the senate, officers of the Lake Carriers' Association are preparing to agree upon a policy to be pursued with reference to raft towing regulations for the harbors of Duluth and Superior. As noted in the REVIEW last week, the general raft towing regulations for the lakes, which are included in the river and harbor bill as passed by the house, will be supported by the vessel interests in the senate, but as Senator Mitchell has introduced an amendment making special regulations for Duluth and Superior harbors, it is probable that the Lake Carriers will submit to some modifications in the regulations for these harbors. This subject formed one of the principal topics of discussion at a meeting in Cleveland, Tuesday, of the finance committee of the association. While it is agreed that the lumber interests at the head of the lakes should be given consideration, the amendment proposed by Senator Mitchell will not, however, be allowed to pass in its present form if it can be prevented. Acting upon the following expression of opinion from Capt. McDougall, the committe instructed Mr. Goulder, counsel of the association, to communicate with the legislative committee in Buffalo, with a view to seeking a compromise with regard to Senator Mitchell's amendment:

"Personally I feel with the other vessel men here that we should make some concessions to the lumber interests, although none of them have ever consulted any of us relative to the matter that I know of. Senator Mitchell's amendment provides rafts for Duluth 150 feet wide and 1,200 feet long and for Superior 200 feet wide and 1,200 feet long, to be handled by two tugs. This all reads very well, but in practice it may be made as abusive as at present. I feel, however, and so do many others with whom I have talked, that this amendment might be modified some and made to read as follows: 'For Duluth and Superior, rafts to be 150 feet wide and 1,000 feet long, and each to be handled, while entering the harbor and while in the harbor, by the same tug that towed it from its starting point, or a tug of equal power, and to be assisted by two other tugs, to keep the raft out of the way of ships.' If this were compulsory, I think it would suit the lumber interests and would interfere very little with the shipping interests, but if Senator Mitchell's amendment carries, the raft could be 200 feet wide, and when once inside of the piers two 'mosquito' tugs could be put to handle it, and thus make it fully as objectionable as at present. The light-house department is now disposed to place buoys all over this harbor, to show the location of all of the new channels, and if rafts similar to those proposed in Senator Mitchell's amendment are allowed to be towed with two tugs of limited means in this harbor they will constantly be removing the buoys that are to be placed there."

An Obstruction Above The Sault.

As a result of the costly accident to the Minnesota line steamer Mariposa, which struck a ledge of rock about half a mile above the Sault canal, on the port side of the channel, it has been learned that damage to the steamers Pathfinder, John W. Moore and Onoko at different times in the past was due to striking the same obstruction, and it is thought to be a long stretch of rock that is buoyed only at the lower end. Capt. Mallory of the Mariposa gave a description of the place to the Finance committee of the Lake Carriers' Association at its meeting Tuesday, and Capt. George P. McKay, Capt. John W. Moore and Mr. H. G. Dalton were appointed a committee to communicate with the light-honse officials with a view of having the entire obstruction properly buoyed, and also to take steps towards securing its removal if it is possible to do so.

About June 30, the steam siren at Port Austin reef light station, off the entrance to Saginaw bay, will be discontinued, and thereafter the fog signal will be a 10-inch steam whistle, sounding blasts of seven seconds' duration, separated by silent intervals of eighty seconds.

AN EXTRA COPY OF THE PHOTO-GRAVURE SUPPLEMENT OF DIRECTORS OF THE LAKE CARRIERS' ASSOCIATION, TOGETHER WITH THE LARGE ENGRAVING OF THE STEAMER NORTH WEST, BOTH OF WHICH ARE CONTAINED IN THIS ISSUE, WILL BE MAILED IN A PASTEBOARD TUBE TO ANY ADDRESS UPON RECEIPT OF 50 CENTS IN STAMPS.

How Borings Were Made at Diamond Shoals.

Diamond shoals, which run from Cape Hatteras, N. C., ten miles out into the ocean, and upon which many vessels have been wrecked and numerous lives lost, have furnished the subject of many newspaper articles since the United States light-house board began the work of trying to light the place. Since the loss, two years ago, of a caisson that had been sunk by contractors at a heavy expense, the light-house board has, on its own account, been trying to ascertain the character of soil under the shoals, as there is an appropriation of $500,000 available for a light-house.

Under the direction of the board, Julius E. Rettig, superintendent of construction, some time ago began the construction of a simple but ingenious apparatus which is described in the Baltimore American. It had the form of a skeleton prism, 20 feet square and 32 feet high, built up of hollow wrought iron columns, hollow wrought iron struts and tie rods, and cast iron sockets at the corners, carrying on the upper end a platform. The structure weighed about thirty-two tons, and was floated by two pontoons, each 24 by 9 by 6 feet, which were clamped to the structure so that they could be liberated as soon as the skeleton was sunk upon the shoal. Through each of the four hollow vertical columns of the structure passed a solid wrought iron pile, 6 inches in diameter and 50 feet in length, having on its lower end a cast iron disk 3 feet in diameter and on its upper end a screw thread and a cast iron flange nut. The pile was held up by a clamp neatly fitted into a recess, which was fifteen feet from the upper end. The disk at the lower end was cored in such a manner that a water current could pass through it and that the water could escape through two 1½-inch openings through the face of the lower disk. A number of wrought iron water pipes and lines of rubber hose were also put on this structure, in order to conduct water under pressure from the tugboat, which was in attendance, to the four disks.

The apparatus was erected first upon a barge and then lifted off by the large shears at Newport News and transferred to the water. When properly rigged for transportation to the site, it drew 21 feet. In this condition the apparatus was towed out to the shoal and after waiting a day or two for favorable weather the structure was successfully sunk at a point previously marked by the United States Coast and Geodetic Survey. Within fifteen minutes afterward the pontoons were disconnected and drifted off, and when the vessel had been securely moored alongside the structure, it required but three-quarters of an hour to sink the iron disks of the piles 13 feet below the bottom of the ocean. By bolting the flange-nuts of the piles to the upper sockets of the structure, the apparatus was completely secured to the bottom. In order to determine the character of the soil, a pipe of two inches in diameter was sunk from the platform of the framework into the bottom of the ocean to a depth of 105 feet.

This is the first time that borings have been made by such an apparatus in such manner, and the whole work, as designated, proved a complete success in its application. The planting of the frame work at the site and making the borings occupied in all only nine and one-half hours. The material brought up from the depth of 105 feet consisted of fine black alluvial sand, mixed with small shells and mud—a material most unfavorable for carrying heavy loads, and easily scoured by the strong current existing on the shoals. The results thus far obtained seemed to indicate that perhaps a skeleton structure, with its lighter weight and small wind and wave resistance, will be more suitable to the conditions than a solid building, especially when it is considered that the appropriation made by congress is far too small for the latter even if such were feasible, but ample for a skeleton one. The cost of making this examination of the soil was but $6,000.

Electric Canal Towage.

The Electric World of recent date illustrates and describes a system of electrical towing for canals, invented by T. D. Davis of New York. The system provides for towing canal boats in tows or trains by an electric motor running on a narrow gauge track on the bank of the canal. Each end of the boat is connected to the inner rail by a triangular guide, the outer end of which is directed with a horizontal guide-wheel on each side of the rail and also a vertical wheel carrying the weight of the free end. These guides hold the boat at a uniform distance from the bank and the boat therefore requires no steering. By this system many more boats can be moved through locks, and the amount of traffic depends upon the locking, the capacity of a canal will thus be largely increased. With a lock provided with electrical equipment and the boats delivered at the locks, the time for locking can, it is claimed, be greatly reduced through this system.

Automatic Operation of the Rudder.

A French publication devoted to electricity describes a device that is intended to operate the rudder of large vessels automatically by the compass directly, without the use of seamen now employed at such work. Attention is called to the fact that the errors in the ordinary method are scarcely less than from 1° to 2°, corres ponding to a lateral error of about twelve miles per day. With the present method greater accuracy is said to be possible; the standard compass is used, and a current from a Ruhmkorff coil is passed from the pivot of the needle to the north pole extremity, whence sparks of three millimetres' length pass to one of two semi-circular pieces of aluminum insulated from each other, the gap between them being set to the desired sailing direction. When the spark passes to one of these the current, by means of a relay, starts a motor in one direction, which in turn operates the rudder, while if the spark passes to the other piece, it moves the rudder in the other direction. An additional device is mentioned, in which these sparks pass through a strip of paper, by means of which a record of the rudder movements is automatically kept.

The Ericsson and Other Torpedo Boats.

Secretary Herbert has ordered the trial trip of the torpedo boat Ericsson to take place during the coming month, and a great deal of interest is manifested in the boat, as she was built at Dubuque, 1,500 miles from the ocean, and is expected, with Thornycroft boilers and triple expansion engines to show great speed. She was designed to be longer and broader than the famous Cushing, without drawing so much water. Completed, with slight changes in the design originally adopted, the Ericsson will compare with the Cushing as follows:

Ericsson—Length, 154 feet; width, 15½ feet; draft; 4¾ feet; indicated horse power, 2,500; 24 knots speed; displacement, 150 tons.

Cushing—Length, 138 feet; width, 15 feet; draft, 5½ feet; 1,720 horse power; 22 knots speed; displacement, 116 tons.

The general construction of the vessel is on the transverse system, and special attention has been given to the longitudinal strength and stiffness by the use of an intercostal vertical keel and broad, heavy stringer plates. At the bow a turtle-back deck works into and terminates in the conning tower. The armament of the vessel will consist of one fixed tube in the bow for firing the Howell torpedo; two diverging tubes on a training circle aft for the firing of the Whitehead torpedo, and four 1-pounder rapid-firing guns. The turtle-back deck is also worked in a way to accommodate the torpedo tube and loading gear in the bow.

The motive power was designed by the bureau of steam engineering, and consists of two propelling engines (rights and lefts) of the vertical, inverted, drect-acting, quadruple expansion type, with Thornycroft boilers, all placed in a common water tight compartment. These are calculated to give a speed to the vessel of about 23 knots working at 412 revolutions a minute, and under a steam pressure of 250 pounds to the square inch. The weight of all machinery, boilers, auxiliaries and contained water, but exclusive of all stores, spare parts, steering-gear and capstan, is less than fifty-two tons. An electric plant for lighting the vessel by the incandescent system and for operating a search light has been provided. This plant is installed in the engine room.

To make the special character of the Ericsson plain, a comparison with some of the latest built torpedo boats of the British and French navies is herewith given:

Vessels.	Length.	Displacement.	Speed.
Ericsson, United States	154 ft.	150 tons	24 knots.
Havock, British	180 "	110 "	27 "
Conreur, French	149 "	114 "	23.5 "

Freight Steamer I. W. Nicholas.

The steel package freight steamer I. W. Nicholas, building for the Minch estate and others by the Cleveland Ship Building Company, will be launched early in August. She is building under the rules and inspection of the Bureau Veritas, and will compare favorably with—if not surpassing—the latest steamers of the package and general cargo class. Some important improvements will be shown in the boat's freight handling appararatus, the engine for which will be 12 by 12 inches and the pinion wheels made of paper. Her capstan and windlass are furnished by the American Ship Windlass Company, and the steering engine represents the latest improvements made by Williamson Bros., Philadelphia. She will be run by Capt. Wm. Gerlach and Engineer William Miller, both of whom were formerly of the Onoko.

C. & B. LINE, FOURTH OF JULY PROGRAM.—The popular C. & B. Line announce a rate of $2.50 from Cleveland to Niagara Falls and return, leaving here on their steamer State of New York on the evening of the 3d and returning to Cleveland early on the morning of the 5th. This allows the entire Fourth of July for sight seeing at either Buffalo or the Falls, and there is no doubt but that a large party of Clevelanders will take advantage of the trip, as the rate is probably the lowest that the line will make for their Falls' trips this season. Also on the morning of the Fourth, the steamer State of Ohio will give a special excursion to Beach Park at the very low rate of 50 cents for the round trip. Those wishing to escape the dust and heat of the Fourth at home should take this pleasant take ride. Music for dancing will be provided on the steamer and at the park. The steamer returns at 5 p. m.

PROOFS of the large supplement of the North West on heavy enameled card board will be sent by the REVIEW to any address for 75 cents.

New Boats—Ship Yard Matters.

The Minnesota Iron Company has asked for figures from some of the ship builders on two steel tow barges. From this it would seem that the management of the Minnesota boats is inclined to favor, to some extent at least, the towing of barges, instead of having a big fleet of steel steamers run light at all times. The company's experience with the Pathfinder and Sagamore, which are practically a part of the Minnesota line, has probably prompted a disposition toward the towing system, as that tow has carried immense cargoes, and the steamer gets around with her big barge almost as rapidly as some of the larger freight steamers running without a tow.

Mr. F. W. Wheeler of West Bay City has been in Cleveland several times of late figuring with a prospective vessel owner, who is reputed to be very wealthy but who is entirely unknown to lake vessel men, for a steamer 400 feet long and 44 feet wide, but the negotiations are understood to be at an end. It was this that gave rise to the report that Mark Hopkins and others interested in the Centurion were to build another immense freighter.

The steamer Kearsarge, just turned over to the syndicate of owners for whom she was built by the Chicago Ship Building Company, is expected to carry big loads of package freight. She will push the steel steamer Gratwick and other big ones very hard in this regard.

Some rapid work may be expected at the yard of the Union Dry Dock Company, Buffalo, in putting together the hull of the new Cleveland fire boat. The time allowed for the work is very short, but Supt. Gaskin, who was in Cleveland a few days ago, says the boat will be delivered in the time specified.

The new side-wheel steamer to be built by the Detroit Dry Dock Company for A. Wehrle and others of Sandusky will be 160 feet keel and 28 feet beam, being two feet longer and wider than the City of Sandusky, which she is to replace. The engines and boilers of the Sandusky will be placed in the new hull, together with all the other machinery which can be used to advantage. The new boat will cost, by this arrangement, about $50,000, and will be completed in time for next season's business.

Col. Dick of Meadville, Pa., president of the Pittsburg, Chenango & Lake Erie Railway Company, which has within the past two years constructed a railway between Pittsburg and Conneaut, with extensive coal and ore docks at the latter place, is still negotiating for the establishment of a car ferry line between Conneaut and Port Dover, Ont., although there is, of course, no truth in the report that a contract for the boats had been let. In a proposition to the Dominion government, the Conneaut company agrees to build for this service not less than two steel ferry steamers costing $400,000, if the necessary dredging is done at Port Dover. General Manager Seargeant of the Grand Trunk Railway endorses the scheme, and says his company will undertake considerable expense to prepare for the proposed international service. General Manager Shaughnessy of the Canadian Pacific Railway says that his company's coal supply as far up as North Bay would come via this route. The boats, if built, will be 300 by 55 feet, with four tracks each, and with a capacity of thirty cars each. The distance across Lake Erie is short, and it is thought that with high power the boats could be designed to make two trips each per day.

Around the Lakes.

A project for an elevator to handle salt in bulk is under consideration in South Chicago. The plan is to handle salt as grain is now handled in elevators.

Mr. A. U. Sheldon, naval architect at the Globe works, Cleveland, will shortly take a vacation. He will make the voyage to Europe and return on one of the Cunard company's big new ships.

A corporation capitalized at $100,000 has been found to manufacture and operate a machine designed for open-pit mining on the Mesabe range. It is a combination conveyor and clam-shell dredge.

Assistant General Manager F. P. Gordou, of the Northern Steamship Company, slipped and fell on the deck of the steamer North West last Sunday afternoon during the squall, spraining his ankle badly.

Citizens of Lorain, Lake Erie, are to vote on the question of expending $100,000 for improvements in the harbor. Work on the big new steel plant of the Johnson Company at this port is progressing rapidly.

Tonnage passing through the Sault canal thus far this season has been very heavy, on account of the great bulk of the largest vessels of the lake fleet being engaged in carrying ore from the head of Lake Superior.

The Craig Ship Building Company is about to construct at Toledo a dry dock 350 feet long and 90 feet wide with 16 feet depth of water over the sill. The excavation will be made by George Dupuis of Detroit.

Mines within the corporate limits of the city of Ironwood, Gogebic county, Mich., will pay taxes this year on an assessed valuation of $4,100,000 as follows: Norrie $1,100,000, East Norrie $500,000, Pabst, $600,000, Newport $650,000, Aurora $600,000, Ashland $650,000.

Capt. Millen, recently appointed local inspector of hulls at Detroit, is succeeded on the Iron Chief by Capt. William Irvine, of the Iron Age, and the vacancy left by the latter is filled by Capt. Horace Bogart, who was in command of the Minnesota when she sank in the Straits of Mackinac last April.

Capt. John C. Floor, who was killed aboard the steamer Spokane at Duluth, was best known as master of the big schooner Golden Age. When the Golden Age was laid up in the spring he remained ashore but later shipped as mate of the Spokane. He was an active member of the Ship Masters' Association. His home was in Buffalo.

New lists of beacons, buoys, etc., on the lakes have been prepared by the light-house board, and can be secured by any vessel master upon application to the office of the light-house board, Washington, D. C., or to the inspector of the ninth light-house district at Buffalo, N. Y., or the inspector of the eleventh light-house district at Detroit, Mich.

Managers Caldwell and Evans of the Western Transit and Anchor lines, Buffalo, are still meeting the expense of having men patrol the beach in the vicinity of Point au Barques and Sand Beach, after every storm, in hope of recovering more of the bodies of men lost from the crew of the Albany and Philadelphia, in the collision of November last.

A record of passengers carried by steamers of Detroit, as reported to the local steamboat inspectors of the district, shows that in 1893, the total was 5,263,000. These figures do not seem unreasonable when it is known that they include reports from the river ferries, excursion boats, and small pleasure craft of all kinds as well as passenger steamers owned in and around Detroit.

Attention is called to the advertisment of Dean Bros'. Steam Pump Works, Indianapolis, Ind., which appears in this issue for the first time. The pumps on the Gratwick, as well as those on the new McElroy flyer Unique and many other lake steamers, were furnished by this company. Their independent condensers do excellent work. The company is moving into a new plant, and offers its present plant for sale. It is well adapted for manufacturing purposes.

According to a schedule reported for Mr. C. McElroy's new fast river steamer Unique, she is to leave Port Huron in the early morning, run down to Detroit, up again to St. Clair, fifty miles from Detroit, return to Detroit, and wind up her day's business by returning to Port Huron. The distance covered by this schedule is figured by one of the Detroit papers at 224 miles, and in order to cover such a route in the time allowed it is calculated that the boat must make 16 miles an hour steady, including her numerous stops.

Lake Freight Matters.

Two blocks of ore, one of 50,000 tons and another smaller in amount, were covered a few days ago at 80 cents from the head of Lake Superior, but aside from this transaction the freight market has been duller and more discouraging to vessel owners than it has been at any time since the season opened. The block of 50,000 tons of ore was distributed mainly between A. C. Waldo and A. A. Parker of Detroit and Alvin Neal of Port Huron. With the closing days of the week there was a little encouragement in an advance of the Milwaukee coal rate to 60 cents, and something more of a demand for ore carriers than existed early in the week at 60 cents from the head of the lakes, 55 cents from Marquette and 40 cents from Escanaba.

Notices to Mariners.

About July 10, Grand Haven pierhead (front) light (fixed red) will be moved 278 feet nearer the outer end of the south pier and exhibited from a lantern in the inclosed glazed end of an elevated conduit extending shoreward 378 feet to the pierhead light tower. The distance between the lights will then be about 384 feet, and the lights will, as heretofore, form a range for approaching the harbor, the range line approximating the line of direction of the outer end of the south pier.

The spar buoy on Sand point off Escanaba has gone adrift. It will be replaced at an early date.

Several advertisers use every other issue of the REVIEW, and as a result their advertisement does not appear in this extra number. We take this means of calling the reader's attention to them: Lake Erie Engineering works, Buffalo, N. Y., having the best equipped plant in America for engine building; Chase Machine Company, Cleveland, O., marine repairs; Hine & Robertson, 40 Cortlandt street, N. Y., steam packing; John Bliss & Co., 128 Front street, New York, N. Y., binnacles and compasses; L. S. Starrett, Athol, Mass., fine tools.

PATTERSON'S Illustrated Nautical Dictionary will be worth $10 in a year or two, as the plates were destroyed by fire. It is an excellent work and will be sent to any address for examination before purchasing. The price is $5. Write the MARINE REVIEW, 516 Perry-Payne Bldg., Cleveland, O.

EXTRA COPIES OF THIS ISSUE OF THE REVIEW CONTAINING ALL SUPPLEMENTS WILL BE MAILED TO ANY ADDRESS UPON RECEIPT OF 50 CENTS IN STAMPS.

Commodore Melville Talks of Triple Screw Ships.

Officers of the bureau of steam engineering, navy department, are, as might be expected, very much elated over the preliminary trial performance of the triple screw cruiser Minneapolis, and a rate of speed greater than that of the Columbia is confidently expected on the official trial, which will take place about July 9. Commodore Melville, chief of the bureau, is receiving special congratulations on account of opposition met with when he proposed three screws for the Columbia when designed in 1890. The Washington correspondent of the Iron Age thus quotes Commodore Melville with reference to these ships:

They were designed to be the fastest vessels of the cruiser type in the world. The Columbia has already attained that position, as no other vessel larger than the torpedo boat class has ever made 22.8 knots, the speed which she attained, and no other vessel, either of the torpedo boat or any other class, has maintained such an average speed for four hours. I was disappointed that the machinery of the Columbia was not worked to its full power. It is expected that the full 21,000 horse power for which the engines were designed will be obtained in the Minneapolis. She ought to do better. The contractors are confidently claiming at least 23 knots and possibly 23¼. I believe she will do it. The main object was to reduce the size of the shafting necessary. The New York was designed for 16,000 horse power expended through twin screws. She had four sets of engines, two on each shaft, which multiplied the number of parts rather more than was desirable, and the shafting abaft the after engine had to be just as large as if all the power had been put in through a single large engine. As the Columbia was to develop 21,000 horse power, it would have required shafting capable of transmitting 10,500 horse power if twin screws had been used, while with triple screws each shaft would only have to transmit 7,000 horse power, which was less than the horse power going through a single shaft in the case of the New York.

"The trial of the Columbia showed a decided increase of economy. The comparison was made according, to Froude's law between the New York and Columbia. The Columbia's advantage in economy was 10 per cent.

"But the use of multiple screws for propulsion is not new. During the civil war a number of light draft boats used on the Mississippi river, familiarly known as tin clads from their carrying a very thin armor of boiler plates, were driven by four screws. The use of multiple screws, however, was adopted because it would have been impossible to fit one or two screws of sufficient size to secure the propulsion. The Russian circular monitors, known as Popoffkas, built in 1874, had six screws. These were failures, so that nothing definite could be told as to the advantage of the use of multiple screws. In 1880 the Russian imperial yacht Livadia was fitted with triple screws, doubtless on account of her peculiar shape, since she was 246 feet long and 153 feet broad by only 7 feet mean draft. The Livadia also proved a failure. In 1884 and 1885 the French government made some elaborate experiments on a small steam launch fitted with triple screws. As a result the Dupuy de Lome, 6,300 tons, was built with triple screws. Her official trials, owing to an accident to one of her boilers, were interrupted and have not yet been completed. In 1887 a torpedo cruiser called the Tripoli was built for the Italian navy. She is 800 tons, and the performances of the triple screws in every case were satisfactory. Several other vessels of similar type have also been built for the Italian navy with triple screws. The Kaiserin Augusta of the German navy is the only triple screw steamer of large size whose trials had been completed before those of the Columbia. Her displacement on trial was 5,000 tons and her horse power about 12,600, so that in both respects she is much below the Columbia and Minneapolis, which have a displacement of 7,350 tons and a horse power of 21,000. Besides the Dupuy de Lome, the French are building several ironclads which are to have triple screws. England alone stands off. She is building the Powerful and Terrible, with about 30,000 horse power each, with twin screws. The director of naval construction in England, however, says that they are not as yet sufficiently convinced of the superiority of triple screws over twins to cause them to adopt this method of propulsion.

Official Numbers and Tonnage.

The bureau of navigation, E. T. Chamberlain commissioner, assigned official numbers and tonnage to the following lake vessels during the week ending June 16: Sail—Crusader, Chicago, 27.84 tons gross, 26.45 net, No. 127,093; Nellie Johnson, Grand Haven, 41.27 tons gross, 39.21 net, No. 130,667; Valiant, Chicago, 9.14 tons gross, 8.68 net, No. 161,741. Steam—Fire Proofer, Chicago, 9.37 tons gross, 6.73 net, No. 120,972; Kirk S. Blanchard, Buffalo, 112.53 tons gross, 67.49 net, No. 161,060: Satisfaction, Milwaukee, 47.75 tons gross, 23.88 net, No. 116,628; W. J. Hingston, Buffalo, 22.09 tons gross, 11.05 net, No. 81,474.

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Cornell School of Marine Construction.

In a circular received from W. F. Durand, principal of the School of Marine Construction, Sibley College, Cornell University, the attention of draughtsmen and others in practical life is directed to opportunities for special study offered at the school. Special students, not candidates for a degree, are admitted without examination to any of the courses under the following conditions:

Special students must be twenty-one years of age, and their training and preparation must have been such as to enable them to carry on with profit the work which they propose to take. Under these conditions, persons who may already have some knowledge of the subject but who may wish to acquire a more exact knowledge of fundamental principles and approved methods, or who may wish to pursue special studies on certain topics connected with the subject, may spend with great profit, a year or more in this school in the special work in which they seek better equipment. The work of the school is very largely individual, so that each one is able to make the greatest possible advancement in the given time. The regular work of the school involves introductory and advanced courses in naval architecture, ship building and marine engineering, and special students are admitted to any of these courses which they are able to pursue with profit. The opportunities thus offered to the special student in marine construction are briefly as follows:

(1) The opportunity of supplementing such knowledge as he may already possess with a more thorough knowledge of the underlying principles and controlling theories, thus enabling him to work more intelligently and efficiently.

(2) The opportunity of becoming acquainted, through his teachers, with the combined best thought, study and experience throughout the world, so far as they may be available and attainable.

(3) The opportunity of pursuing under the most favorable circumstances, and with the help of extensive libraries and apparatus, and the advice of trained specialists, special problems in this field in which he may have a personal interest.

Detail regarding the regular courses, equipment of the school, tuition, etc., may be secured by addressing W. F. Durand, principal, Ithaca, N. Y.

Knots and Miles.

One of the writers of department items in Cassier's Magazine refers to the old error of confounding the knot and the mile. He says: "One of the things which it seems difficult for the public mind to grasp is that there is a decided difference between the knot and the mile. It is certainly about time to have it thoroughly understood that the two are not the same thing. It seems easy enough to remember that a mile is only about 87 per cent. of a knot, the latter being approximately, 6,082 feet in length, while the statute mile measures 5,280 feet. Three and one-half miles are equal, within a small fraction, to three knots. The result of this difference, of course, is that the speed of a vessel in miles per hour is always considerably larger than when stated in knots, and the confusion of the terms sometimes gives rise to rather remarkable claims of speed performance. When a 20-knot ship, for example, is lightly mentioned, it should be remembered that this really means a little over twenty-three miles. Similarly, with higher figures, which are often glibly enough stated, the difference between the terms is worth bearing in mind. It will help to guard against the forming of ridiculous estimates of a vessel's capabilities.

In General.

Considerable progress is now being made with the construction of the new gunboats Albatross, Penguin and Porpoise at the works of the Newport News Ship Building and Dry Dock Company.

Boilers of the Chicago have given out and are to be repaired at Antwerp. The Navy department contemplates putting part Scotch and part tubulous boilers in this boat upon her return to this country next fall.

President Ingalls of the Chesapeake & Ohio Railway Company is in England, and it is thought that he will consider with Clyde ship builders the question of adding more new freight steamers to the line of six new ships recently established on the route between Newport News end Liverpool. The Atlantic line of the Chesapeake & Ohio company has greatly increased the export business of the railway from Newport News.

Some one has estimated the number of men engaged in the recent strike of bituminous coal workers at considerably over 100,000; that during the time they were laid off from work they lost in wages about $12,000,000, and that the total loss, to the miners themselves, to the several states involved, owing to the military expenditures, to the railroad companies and others in the destruction of property, to the purchasers of coal at advanced prices, and to mine owners, not all of whom were heavy losers, will not fall short of $20,000,000. The strike was the greatest in magnitude of area and the costliest in dollars and cents on record in this country.

Illustrated Patent Record.

SELECTED ABSTRACTS OF SPECIFICATIONS OF A MARINE NATURE—FROM LATEST PATENT OFFICE REPORTS.

521,494. Adjustably-Weighted Center-Board. Francis W. Brewster, Bournemouth, England. Filed Feb. 19, 1894. Serial No. 500,631.

Claim—In combination, a pivoted center-board, a ballast-carrying tubular closed bulb of angular or curved formation secured to the lower edge or part of the center-board and formed with inner rails or guideways, and contained adjustable ballast adapted to automatically roll or slide along and within the bulb to the lowest part thereof upon the center-board being raised or lowered, and means for raising and lowering the center-board.

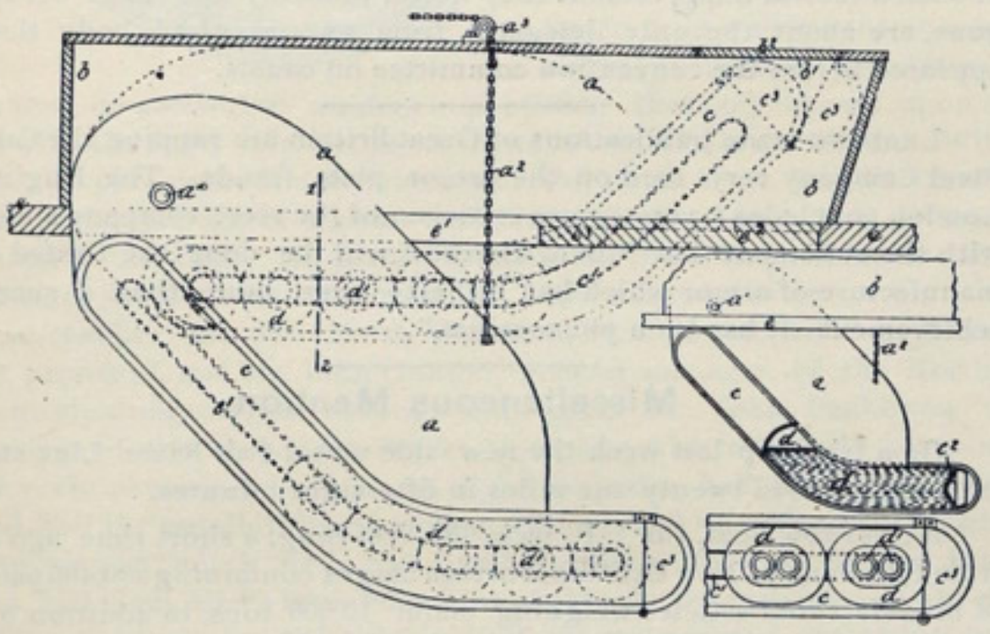
521,527. Canal Towage. Joseph I. Morris, Camden, N. J.. Filed July 19, 1893. Serial No. 480,955.

Claim—In a canal and waterway towage system, the combination of a continuous motion endless cable arranged and operated above the surface or sides of a canal or waterway, a removable grip consisting in a fixed jaw which embraces said cable and is suspended therefrom, and a movable jaw having a vertical movement by means of a rack and pinion operated by a line or connection from a boat, and tow line between the grip and boat.

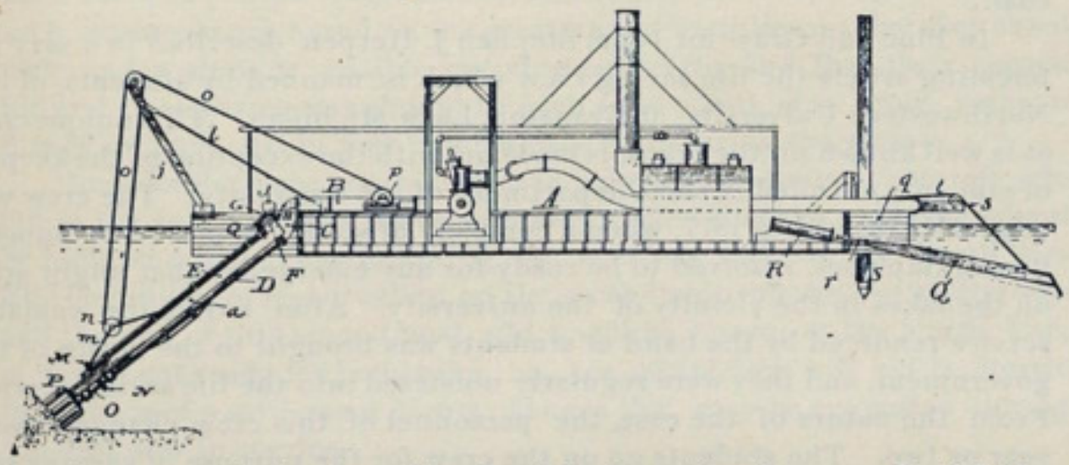
521,536. Row-Boat. Michael F. Davis, Portland, Me. Filed June 28, 1890. Renewed Sept. 4, 1893. Serial No. 484,796.

Claim—First, in a row boat, the body or skin A lined internally at B with suitable material and combined with the strip C, covered with the material D, and secured to the inside face of the boat by the margins of said covering. Second, in a row boat, the skin A lined on the inner face as set forth, and having between it and the keelson several layers of lining. Third, in combination with the wooden skin of the boat, the covered strengthening strip C, secured by cement, or otherwise, to and upon the inside of said skin by means of the free ends of the cover.

521,494. ADJUSTABLY-WEIGHTED CENTER-BOARD.



521,580. DREDGER



521,580. Dredger. Lindon Bates, Chicago, Ill. Filed Feb. 19, 1894. Serial No. 500,750.

Claim—First, in combination with a boat having a fixed elbow; a ladder pivoted to the elbow; a suction pipe carried by the ladder and having a curved end to fit the elbow; a rotatable pipe-section 10 provided with a cutter and a gear ring N; a shaft extending lengthwise of the ladder and provided with a pinion M to engage the gear ring; and means for rotating the shaft. Second, in combination with the boat having the curved elbow; the ladder provided with a suction pipe having a curved end; a rotatable cutter carried by a rotatable section of the pipe; a gear ring N; the shaft F provided with gears G H; the shaft I provided with gear J; and a shaft L provided with gears M and Q.

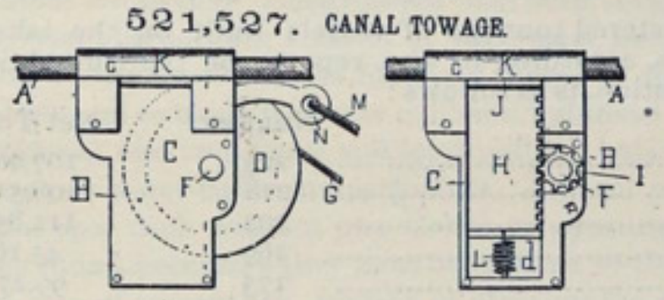
521,652. Steam Steering Apparatus. Edward Heyde, East Saginaw, Mich. assignor to Wickes Brothers, same place Filed Dec. 23, 1893. Serial No. 494,566.

Claim—First, in a steam steering apparatus, the combination with a steam cylinder aud its piston rod, of a cross head carried by said piston rod, two sheaves carried by the cross head, chains each having one end made fast and carried over said sheaves respectively in opposite directions and connected to the tiller, a steam valve, a valve gear actuated by the piston rod, and means for manually controlling the valve independently of the movements of the piston rod. Second, in a steam steering apparatus, the combination with a steam cylinder and its piston and piston rod, of a valve for controlling the cylinder ports, a swinging lever pivoted to the valve rod, a pinion carried by said lever and two sliding racks inmeshed with the pinion, one of said racks connected to the piston rod and means for moving the other rack independently. Third, in a steam steering apparatus, the combination with a steam cylinder and its piston and piston rod, of a slide valve for controlling the cylinder ports, a swinging lever pivoted to the valve rod, a pinion carried by said lever, two sliding racks inmeshed with the pinion, one of said racks connected with the piston rod and moving therewith, a steering wheel, an operating rod turned thereby, a loose pinion carried by said rod and inmeshed with the rack connected to the piston rod, a pinion secured to turn with the operating rod and inmeshed with the other of said racks and a clutch, one member of which is carried by the loose pinion and the other by the rod.

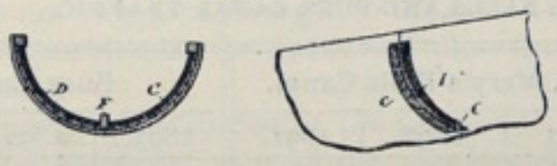
Trade Notes.

On the subject of lubricating pulley blocks, the Joseph Dixon Crucible Company, Jersey City, N. J., recently issued a record of service tests of hoisting tackle, made by Robert Grimshaw, M. E., at the Brooklyn navy yard, in colaboration with Lieut. John A. Bell of the equipment bureau, U. S. N. The tests show that the percentage of saving effected between unlubricated and lubricated blocks, increased with the load, and in some cases it was sufficient to represent the work of one man in three.

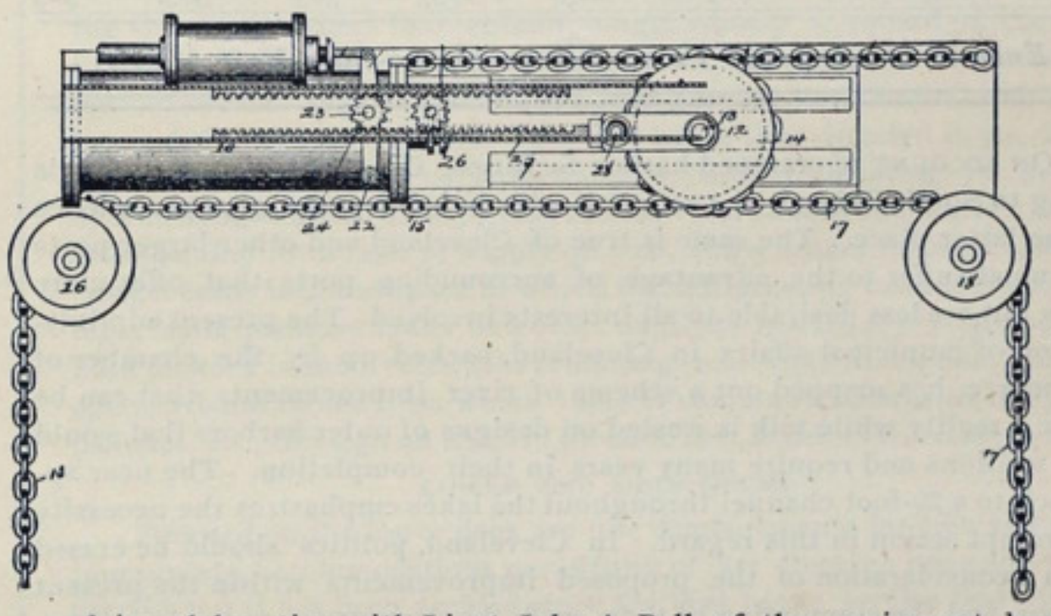
521,527. CANAL TOWAGE.



521,536. ROW-BOAT.



521,652. STEAM STEERING APPARATUS.



Chas. D. Mosher has severed his connection with the New York Ship Building and Engineering Company. This is the concern that makes a specialty of small, fast steamboats. Remaining members of the firm are Col. E. A. Stevens, John D. Cox and William Gardner.

Stocks of Grain at Lake Ports.

The following table, prepared from reports of the Chicago board of trade, shows the stocks of wheat and corn in store at the principal points of accumulation on the lakes on June 23, 1894:

	Wheat, bu.	Corn, bu.
Chicago	18,876,000	29,740,000
Duluth	6,300,000	.....
Milwaukee	1,072,000	3,000
Detroit	1,353,000	13,000
Toledo	2,526,000	59,000
Buffalo	1,136,000	283,000
Total	31,263,000	3,332,000

At the points named there is a net decrease for the week of 796,000 bushels of wheat and an increase of 146,000 bushels of corn.

MARINE REVIEW.

DEVOTED TO THE LAKE MARINE AND KINDRED INTERESTS.

Published every Thursday at No. 516 Perry-Payne building, Cleveland, O. Chicago office, (branch), No. 726 Phoenix building.

SUBSCRIPTION—$2.00 per year in advance. Single copies 10 cents each. Convenient binders sent, post paid, 75 cents. Advertising rates on application.

The books of the United States treasury department contain the names of 3,761 vessels, of 1,261,067.22 gross tons register in the lake trade. The lakes have more steam vessels of 1,000 to 2,500 tons than the combined ownership of this class of vessels in all other sections of the country. The number of steam vessels of 1,000 to 2,500 tons on the lakes on June 30, 1893, was 318 and their aggregate gross tonnage 525,778.57; in all other parts of the country the number of this class of vessels was,on the same date, 211 and their gross tonnage 314,016.65. The classification of the entire lake fleet on June 30, 1893, was as follows:

Class.	Number.	Gross. Tonnage.
Steam vessels	1,731	828,702.29
Sailing vessels	1,205	317,789.37
Canal boats	743	76,843.57
Barges	82	37,731.99
Total	3,761	1,261,067.22

The gross registered tonnage of vessels built on the lakes during the past five years, according to the reports of the United States commissioner of navigation, is as follows:

	Number.	Net Tonnage.
1889	225	107,080.30
1890	218	108,515.00
1891	204	111,856.45
1892	169	45,168.98
1893	175	99,271.24
Total	991	471,891.97

ST. MARY'S FALLS AND SUEZ CANAL TRAFFIC.

	St. Mary's Falls Canal.			Suez Canal.		
	1893	1892.	1891.	1893.	1892.	1891.
No. vessel passages	12,008	12,580	10,191	3,341	3,559	4,207
Ton'ge, net regist'd	9,849,754	10,647,203	8,400,685	7,659,068	7,712,028	8,698,777
Days of navigation..	219	223	225	365	365	365

Entered at Cleveland Post Office as Second-class Mail Matter.

ON ACCOUNT of cramped harbor facilities, Chicago's lake business is going to South Chicago at a rate that will in a few years give precedence to the latter place. The same is true of Cleveland and other larger ports that must suffer to the advantage of surrounding ports that offer more room but are less desirable to all interests involved. The present administration of municipal affairs in Cleveland, backed up by the chamber of commerce, has mapped out a scheme of river improvements that can be made a reality while talk is wasted on designs of outer harbors that would cost millions and require many years in their completion. The near approach to a 20-foot channel throughout the lakes emphasizes the necessity of prompt action in this regard. In Cleveland, politics should be erased from a consideration of the proposed improvements within the present harbor, and the completion of them made binding upon any administration of local government that may follow.

TO PEOPLE who are aware of the great increase in power and other conditions that must attend steamboat speeds above 20 knots, or even 20 statute miles, some of the stories that are told of wonderful boats to run 25 knots or more are ridiculous. A summary of a year's work with the great Cunard steamers Campania and Lucania shows a mean speed throughout of 20.35 knots an hour for the two vessels. This represents a gain of only 1¼ knots, or 6 per cent. over boats like the New York, Paris, Majestic and Teutonic, and yet it is among the best judges thought to be about all that could be expected for the enormous additional expense to which the owners of these boats were put in aiming to secure increased speed.

SOMEONE has told one of the Duluth newspaper reporters that the weather bureau is ready to begin immediately the work of forecasting twenty-four hours in advance, the draft of water over the miter sill at the St. Mary's Falls canal. This is to be done on the theory recently advanced by the bureau regarding the effect of atmospheric pressures on the waters of Lake Superior. We have heard of no official announcement of the bureau's readiness to begin this work so soon after the advancement of the theory referred to, but it is quite certain that whenever an attempt at such forecasts is made, they will prove quite wide of the mark when sudden changes occur.

IT WOULD seem that Congressman Lockwood of Buffalo, who might be expected to encourage rather than oppose the shipping interests of the lakes in congress, is determined to bring before the house a clause in the immigration bill that aims to send vessel owners and masters to prison for employing, in any capacity, on their vessels, aliens who have not been domiciled one year in this country, although the vessel men have no way of knowing how long an applicant for employment has resided here. The immigration bill may leave the house committee with this clause included among its provisions, but there is little chance of its passage in such form, especially in the senate.

EACH SUCCEEDING report from the treasury bureau of statistics covering the part taken by American vessels in the sea going trade is to the advocates of protection for American ships more discouraging than the one preceding it. From the report covering six months ending with December, 1893, it is learned that the value of imports in American steam vessels was $30,345,344, and imports by sailing ships aggregated $17,337,358, the total for both being $47,672,702. Imports brought in by foreign bottoms are thus given: By steam vessels, $312,317,102, and by sailing vessels, $16,152,422, making a total of $328,469,574.

NEW YORK'S constitutional convention will probably follow the old worn out course of trying to secure improvements of the canals through the state alone. Representatives of the canal boatmen, who oppose the project for government aid in securing a ship canal, because in event of such a radical improvement they would probably find their occupation gone, are about the only delegates from an organized body that has appeared before the convention committee on canals.

LEADING trade publications of Great Britain are rapping the Carnegie Steel Company very hard on the armor plate frauds. The Engineer of London concludes a very severe criticism of the steel company's methods with the statement that "great discredit will be done the United States manufacture of armor which has hitherto been more than a successfui achievement—it has been phenominal."

Miscellaneous Mention.

On a trial trip last week the new side-wheel Fall River Line steamer Priscilla steamed twenty-one miles in fifty-eight minutes.

A river tow boat, the J. P. Jack, 190 feet long, a short time ago towed from Pittsburg to New Orleans fourteen barges containing 280,466 packages of manufactured articles weighing about 12,000 tons, in addition to 270,000 brick and 1,000 barrels of salt. At twenty-two tons a car, it is estimated that 600 cars would be required to carry the manufactured articles alone The boat had in tow also her fuel flats and a barge filled with coal.

In Blue and Gray for June, Stephen J. Herpen describes in a very interesting article the life saving crew which is manned by students of the Northwestern University, at Evanston, Lake Michigan. This unique crew as is well known on the lakes, is made up, with the exception of the keeper, of students enrolled in some department of the university. The crew was originally formed in 1877, when a company of students, moved by humanitarian impulses, resolved to be ready for any emergency that might arise on the lakes in the vicinity of the university. After a time the valuable service rendered by the band of students was brought to the notice of the government, and they were regularly mustered into the life saving service. From the nature of the case, the personnel of this crew changes every year or two. The students go on the crew for the purpose of earning sufficient money to carry them through the university.

Spelling of the Name of the New Iron Range.

Among decisions rendered on April 4, 1893, by the United States Board of Geographical Names is one with reference to the spelling of the range of hills in Minnesota, from which the new iron ore district of that state takes its name. The board fixed upon M-e-s-a-b-i as the correct spelling of the name, and it would seem that this spelling should be generally used without further controversy. THE REVIEW is in receipt of an official communication on this subject from the board.

FOR THE CHRISTIAN ENDEAVOR CONVENTION—At Cleveland, the Nickel Plate road offers a rate of one lowest first class fare for the round trip and a splendid passenger service. Tickets on sale July 9, 10, and 11. Return limit Sept. 15.

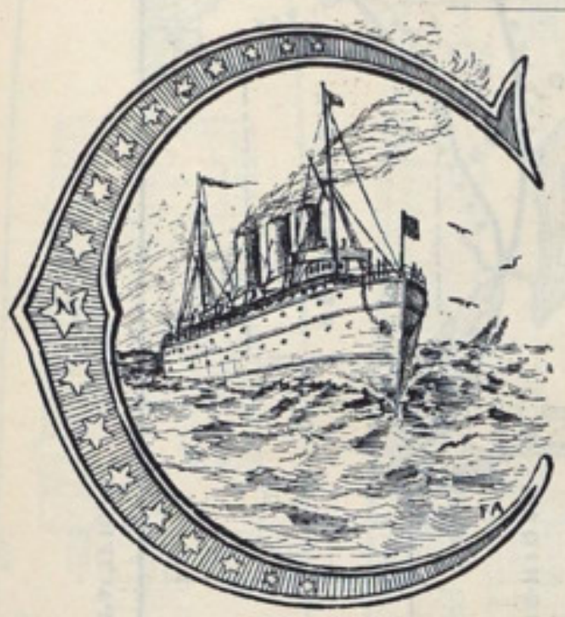
FOURTH OF JULY RATES—On the Nickel Plate road are one fare for round trip. Tickets on sale July 3rd and 4th, good returning until the 5th.

PHOTOGRAPHS of sixteen lake steamers and two color plates will be mailed to any address for 50 cents. MARINE REVIEW, 516 Perry-Payne Bldg., Cleveland, O,

EXTRA COPIES OF THIS ISSUE OF THE REVIEW CONTAINING ALL SUPPLEMENTS WILL BE MAILED TO ANY ADDRESS UPON RECEIPT OF 50 CENTS IN STAMPS.

STEAMSHIP NORTH WEST

FIRST OF THE GREAT LAKE SHIPS EQUIPPED FOR PASSENGERS EXCLUSIVELY—WEEKLY SERVICE BETWEEN BUFFALO AND DULUTH—BELLEVILLE TUBULOUS BOILERS AND QUADRUPLE EXPANSION ENGINES TO DEVELOP 7,000 HORSE POWER.



COMMENT on the size, elegance and the speed of the big passenger steamer North West, which began a regular weekly service between Buffalo and Duluth with the first of the present month, has filled many columns of newspapers throughout the country. Much of it—nearly all in fact—has been of the kind that is of necessity hastily written and not intended for preservation by owners or builders of ships, who would attach great importance to a complete and reliable description of this boat, on account of matters in the future that may depend upon success with the many improvements involved in her construction. With a view to supplying such a description of the North West, THE REVIEW has with special care and at a great cost prepared an edition that is mainly devoted to this boat. No attempt is made to report the performance of the boat since she went into commission. This will come later.

A steamer like the North West has been contemplated by James J. Hill, president, and Mr. John Gordon, general manager, of the Northern Steamship Company, for several years past. Mr. John Pankhurst, vice president of the Globe Iron Works Company, who was fully acquainted with early passenger business on Lake Superior, had the same idea in mind, and the possibilities of success with a grand line of express steamers connecting at Duluth with the Great Northern Railway for the Pacific coast, had many times been talked over between the managers of the ship building campany and the principals of the railway and steamship lines.

It was agreed that boats for the service should be capable of making 20 statute miles an hour on a regular schedule; that money should be spent upon them to provide conveniences and satisfy the luxurious demands of such patrons as are found on the great transatlantic liners; that they should make as few stops as possible, carrying no freight, and that their capacity for first class passengers should be such as to admit of a profit being returned on their cost in four months of service during the season.

Considerable time was taken up in viewing the project from all sides, but in the spring of 1892 it was definitely settled that two such boats should be built, and in August following the keel was laid for the North West. The beginning of construction on the second ship followed soon afterward, and the hull of this second boat, which will be known as the North Land, is now about ready for launching, but her completion will not be hurried in advance of a settlement of any changes that may be suggested through the boat now in service.

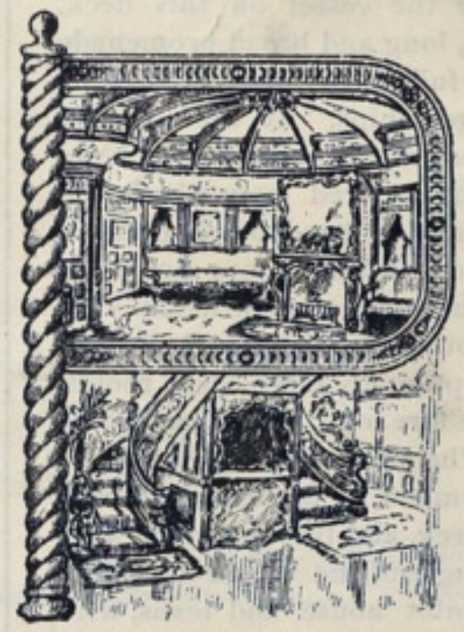
How the Ship is Manned.

A CREW OF 147—FORTY-FOUR IN THE ENGINE ROOM DEPARTMENT ALONE. COOKS, WAITERS, BELL BOYS AND OTHER ATTENDANTS.

A crew of 147 is employed in the operation of this vessel. Capt. W. H. Campau, the supreme authority on board, is one of the best known masters on the lakes. Almost his entire life has been spent aboard ship. The first, second and third officers are, respectively, Frank Welcome, Richard Tyrney and Richard McDermott, all of whom carry government licenses of the first class. The first officer stands no watch, but is responsible for discipline of the crew, sanitary condition of the ship, etc. Chief Engineer McAdams has as principal assistants Alex. Brown and James Gow, and in addition there are in this department two second and two third assistant engineers, ten oilers, six water tenders and twenty-three firemen, making an engine room crew in all of forty-four. A boatswain, boatswain's mate, twelve sailors, four quartermasters, two lookouts, two crew's cooks, kitchen fireman and two mess boys are other attaches of the deck department. In the departments devoted to attention of passengers there are seventy-nine other employes. These include a physician, purser, clerk, two cashiers, two checkers for dining room, chef, second cook, roast cook, fry cook, baker, pastry cook, vegetable cook, two butchers, four pantry men, emigrant steward, head waiter and steward, assistant head waiter, twenty-six waiters, baggage man and three porters, six bell boys, storekeeper and assistant, two barbers, bar keeper and assistant, four omnibus attendants, housekeeper and nine cabin maids.

Leading Features of the Hull.

GREAT STRENGTH SOUGHT THROUGHOUT THE CONSTRUCTION—DESIGN OF ALL PARTS OF THE SHIP FROM THE HOLD TO HURRICANE DECK HOUSES.



PASSENGER ships that carry no freight of any kind are very rare, especially when the route over which they travel is of great length, but the owners of this boat have sacrificed all chances of remuneration from freight traffic in order to carry out their design of a passenger steamer exclusively, and to give to patrons benefit of a rapid voyage, free from delays and annoyances accompanying the handling of freight. This aim has, of course, greatly aided in the design of the boat for the comfort of passengers and crew, as will be seen by the description that follows.

The vessel is 383 feet over all, 360 feet between perpendiculars, 44 feet moulded breadth, 26 feet moulded depth and 34 feet 5 inches depth to spar deck. Great strength of construction has been sought in all parts of the hull, the vessel being built entirely of mild steel, and under the rules and inspection of the United States Standard Register for the highest class. An inner bottom extends from the collision bulkhead forward to the afterpeak bulkhead, and transverse and longitudinal bulkheads divide the hull into numerous water-tight compartments. Several of the bulkheads extend to the spar deck without any doors or openings, and where doors have been found necessary they have been fitted so that they can be readily closed in case of emergency. Instead of carrying the after lengths of shafts through the ship's sides, and exposiug them unsupported for a considerable length, framing and plating is continued around the shafts in such a way as to not only give strength to the after body of the vessel, but also to overcome considerable resistance and allow the water to pass freely to the propellers.

Beginning a description of the various divisions of the hull with that part of it constructed to meet the requirements of the tubulous boilers, which are placed about amidships in three separate water-tight compartments, it may be noted that special arrangements have been made for filling the coal bunkers that extend longitudinally outboard of the boiler spaces on either side. The coaling hatches have been trunked in and the bottom of each trunk is formed into four sloping coal chutes, each leading into a different coal bunker. The coal being thus directed in its fall will spread itself uniformly over the bunkers, thereby obviating the necessity of trimming the coal to any great extent. Forward of the boiler rooms is a cross-bunker for a reserve supply of coal, and a tunnel through this cross-bunker leads into the space in which the refrigerating machinery, freezing tank, water-pressure tanks and other auxiliary machinery is placed. The hold forward is subdivided into trimming and supply tank and cold storage provision rooms from which there is communication with the galleys, pantries, etc., through an electric elevator that is described elsewhere.

LOWER AND MAIN DECKS.

Forward on the lower deck are the compartments for men and women immigrants, accommodations permitting of 211 steerage passengers being carried, but it has been decided since the boat began service that this portion of the ship will be used for other purposes, probably second cabin passengers, as the immigrant business was undesirable, and the freight boats of the Northern Steamship Company are fitted to care for the amount of this traffic that is now to be had. The after part of the lower deck has been fitted up partly as baggage room and partly for the accommodation of a portion of the crew.

On the main deck forward is the large saloon dining room, which is, however, reached by passengers from the saloon deck by means of a grand staircase, and has no connection with the crew's quarters, which are confined largely to the main deck. This dining room, as well as the main entrance with grand vestibule, cafe, etc., aft of the engine space on the main deck, are described further on in the account of cabin arrangements, so that it is enough to say here with reference to this deck that the quarters of officers, immediately abaft the collision bulkhead, and for engineers, clerks and stewards, just aft the engine room, are in every way well suited to comfort. The starboard side of this deck forward of engines is occupied by sleeping and messing accommodations for firemen and sailors, together with numerous lavatories and baths for the crew. On the port side is the officers' mess-room, a large apartment handsomely finished in hardwood, crew's galley with pantry and cold storage room, and the large passengers' galley with bakery and saloon pantry.

SALOON AND HURRICANE DECKS.

As the spar or saloon deck is,—with the exception of spaces at fore and after ends, required for working anchors,—entirely given up to the accom-

modation of first class passengers, and as the great stretch of cabins on this deck is described in the account of interior features of the boat, a view of the upper or hurricane deck may be introduced without further reference to the main saloons. The appearance of the vessel on this deck, where the three smoke stacks, steel pole spars, long and broad promenade and iron and wood deck houses are shown to full advantage, can well be compared to the best of Atlantic going passenger ships. At the fore end of this deck a large deck house has been fitted with exceptionally large and handsome state rooms. This house may be entered from the hurricane deck, or from the saloon deck by means of a handsomely finished staircase. A large, airy and beautifully finished smoking room has been arranged at the fore end of this house, commanding an unobstructed view in front and on both sides of the vessel. Another deckhouse aft covers a length of 115 feet. This house has also exceptionally large state rooms. A ladies' cabin and music saloon occupies the fore end, with a handsome double staircase leading to the saloon deck. The after end is fitted up as a reading room, and is so constructed as to command an unobstructed view astern. A large well has been formed in the deck, and this with the very handsome dome skylight, which extends throughout the whole length of the house, gives it a grand appearance. The pilot house and texas, with upper and lower bridges, are on top of the forward house referred to. In the texas are sleeping and sitting rooms, provided for the captain of the vessel.

LEADING FEATURES OF HULL, ENGINES AND BOILERS.

HULL—

Length over all	383 feet.
" between perpendiculars	360 "
Breadth, moulded	44 "
Depth, "	26 "
Load draft	14 "
Load displacement	4,482 tons.
Tonnage, gross registered	4,244 "
" net "	2,340 "
Capacity of coal bunkers	1,000 "
" " water bottom	682 "
Passengers, cabin	442
" steerage	211
" crew	147
" total	800

ENGINES—

Twin vertical quadruple expansion; high pressure forward, followed by first and second intermediate and low pressure.

CYLINDER SIZES—

High pressure	25 inches.
First intermediate	36 "
Second "	51½ "
Low pressure	74 "
Stroke	42 "
I. H. P., total	7,000
Steam pressure	195 lbs.
Speed at 120 revolutions	20 miles.

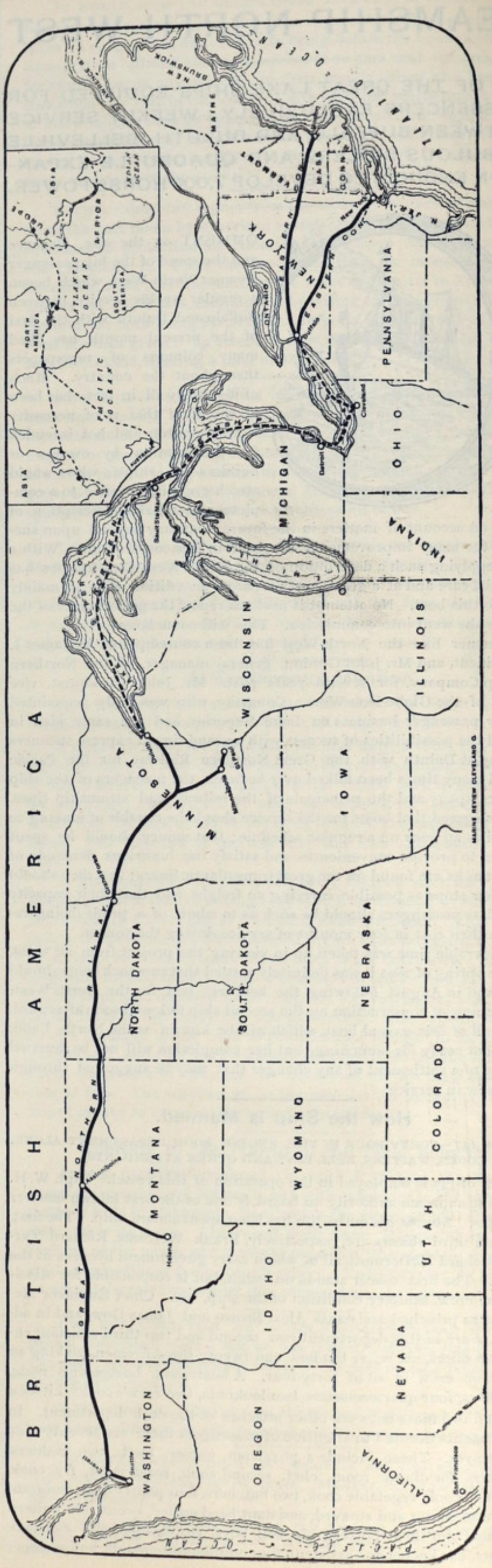
PROPELLERS—

Number of blades	4
Diameter	13 feet.
Pitch	18 "

BOILERS—

Number in forward group	10
" " center "	8
" " after "	10
Total	28
Grate surface, one boiler	29 sq. ft.
" " total	812 " "
Heating " one boiler	920 " "
" " total	25,760 " "
Heating surface for 1 sq. ft. grate surface	31 " "
Pressure allowed	267 lbs.
Total weight of boilers with water	400 tons.
Floor space occupied by one boiler	7′ 9″x6′ 6″
Height from fire room floor	11′ 4″
Grates, "Ætna," shaking.	

As indicating the importance attached to the quadruple engines and tubulous boilers described above, it may be noted that the officers of the bureau of steam engineering, navy department, have made a request for permission to have a board of engineers conduct a series of tests on the boat. The navy department is especially desirous of having its engineer officers observe the Belleville boilers in actual service on a steamer of this kind.



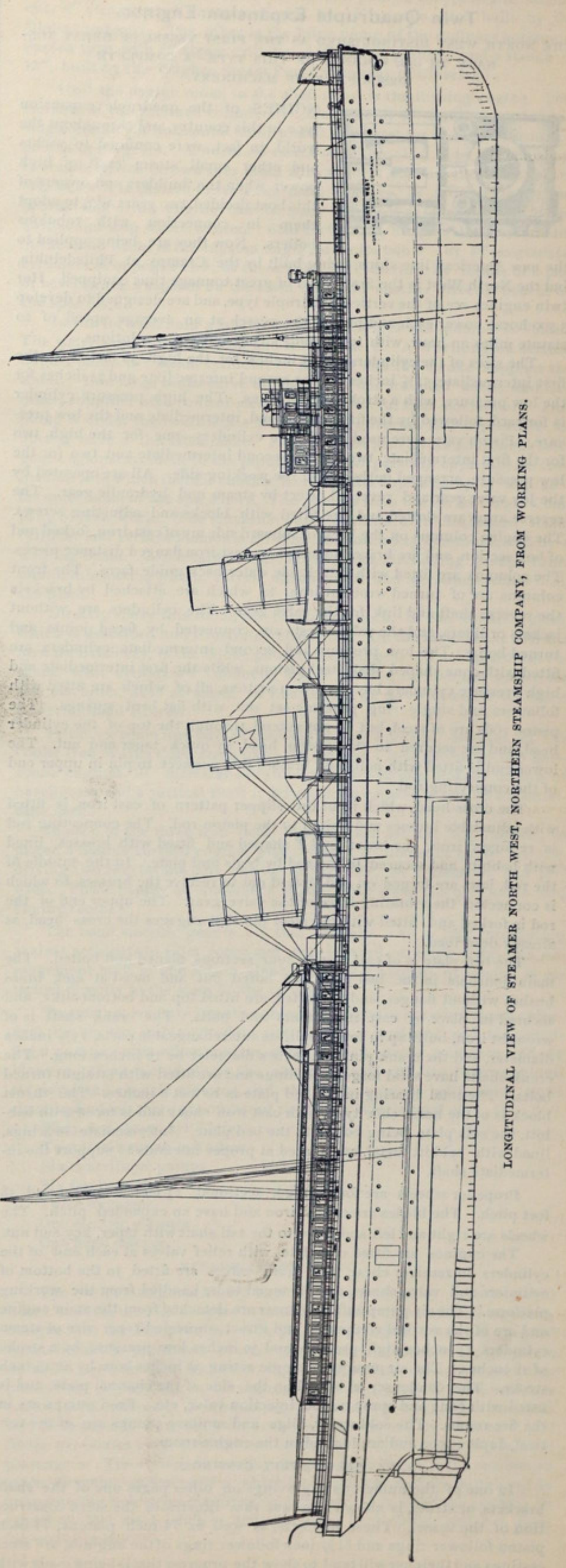
DECK PLANS OF EXCLUSIVELY PASSENGER STEAMER NORTH WEST, NORTHERN STEAMSHIP COMPANY.

UPPER DECK PLAN

SALOON DECK PLAN

MAIN DECK PLAN

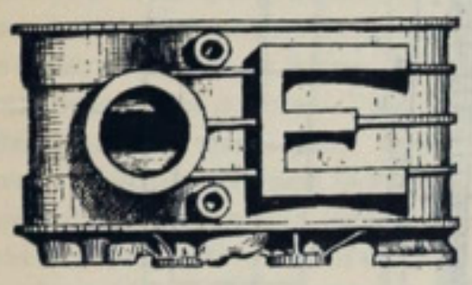
THE M-N. CO., BUFFALO, N. Y. 9462 E



LONGITUDINAL VIEW OF STEAMER NORTH WEST, NORTHERN STEAMSHIP COMPANY, FROM WORKING PLANS.

Twin Quadruple Expansion Engines.

THE NORTH WEST DISTINGUISHED AS THE FIRST VESSEL OF GREAT TONNAGE TO USE ENGINES OF THIS TYPE—A COMPLETE DESCRIPTION OF MACHINERY.



NGINES of the quadruple expansion type in this country, and throughout the world, in fact, were confined to yachts and other small steam craft of high power when the builders and owners of this boat decided, two years ago, to adopt them in connection with tubulous boilers. Now they are being applied to the new American line ships, being built by the Cramps at Philadelphia, but the North West is the first vessel of great tonnage thus equipped. Her twin engines are of the vertical quadruple type, and are designed to develop 3,500 horse power each and propel the vessel at an average speed of 20 statute miles an hour, with 195 pounds steam and 120 revolutions.

The sizes of the cylinders are 25 inches for the high, 36 inches for the first intermediate, 51½ inches for the second intermediate and 74 inches for the low pressure, with a stroke of 42 inches. The high pressure cylinder is forward, followed by the first and second intermediate and the low pressure. Piston valves are used on all the cylinders—one for the high, two for the first intermediate, two for the second intermediate and two for the low pressure, arranged outboard on the working side. All are operated by the Joy valve gear and reversed direct by steam and hydraulic gear. The reverse arms are slotted and are fitted with blocks and adjusting screws. The engine columns on the back or inboard side are of cast-iron, forked and of box section, and are braced together by cast-iron flanged distance pieces. The columns are fitted with detachable water-back guide faces. The front columns are of turned wrought iron, to which are attached by brackets the reverse shaft and link for the valve gear. The cylinders are without jackets or liners, and the valve chests are connected by faced joints and turned bolts. The low pressure and second intermediate cylinders are fitted with cone shaped, disk steel pistons, while the first intermediate and high pressure cylinders have cast-iron pistons, all of which are fitted with followers and single ring packing, set out with flat bent springs. The piston rods are of steel, but do not extend through the top of the cylinder head, and are secured to the piston head by quick taper and nut. The lower end is fitted with bolts and brasses that connect to pin in upper end of the connecting rod.

The cross-head, which is of the slipper pattern, of cast iron, is fitted with adjustable brasses and bolted to the piston rod. The connecting rod is re-forged iron, the lower end T shaped and fitted with brasses, lined with babbitt, and secured to the rod by bolts and plate. In the middle of the rod, jaws are forged on and slotted out to receive the brasses, to which is connected the vibrating lever of the valve gear. The upper end of the rod is forked and fitted with the steel pin that engages the cross head, as already described.

The bed plate is of cast iron in four sections, planed and bolted. The main journals in the bed plate are bored out and faced at end; brass bushes without flanges, and babbitted, are fitted top and bottom alike, and secured in place by cast iron liners and bolts. The crank shaft is of wrought iron, built up in four duplicate interchangeable parts, 13½ inches diameter, and the crank pin is 14 inches diameter by 16 inches long. The crank shafts have solid forged couplings and are fitted with straight turned bolts. The total bearing in the bed plate is 10 feet 8 inches. The thrust block is of the horse shoe type, with cast iron shoes and is faced with babbitt, the sole plate being bolted to the bed plate. Intermediate bearings, lined with babbitt metal, are placed at proper intervals to support the intermediate shaft.

Propeller wheels are four bladed, sectional, 13 feet diameter and 18 feet pitch. The blades are of cast iron and have an expanded pitch. The wheels are right and left and fitted to the tail shaft with taper, key and nut.

The engines are fitted complete with relief valves at each end of the cylinders in receiver chest; and drain valves are fitted to the bottom of cylinders and valve chests, and arranged to be handled from the working platform. The air pump and condenser are detached from the main engine and are of the vertical compound and direct connected type; size of steam cylinders, 15 inches high pressure and 30 inches low pressure, by a stroke of 18 inches. The air pumps are single acting, 38 inches bore by an 18-inch stroke. The condenser is bolted on the side of the channel plate and is fitted with cone and spray nozzle, injection valve, etc. Feed pumps are in the fire rooms. The cold water, bilge and sanitary pumps are of the vertical, duplex type and are located in the engine room.

LARGE STEEL CASTINGS.

In one of the numerous engravings on other pages one of the shaft brackets, or struts, is shown in a way that illustrates the stern construction of the vessel. These brackets, as well as 74-inch pistons, 74-inch piston follower rings and 51½-inch follower rings of the engines, are steel castings, and their use will tend to show the progress that is being made with steel castings in ship construction. The government has of late used steel castings on an extensive scale, in hulls, machinery, gun carriages, mortars, etc., and now in this lake steamer there is evidence of a general demand for them where strength combined with durability and lightness is essential. These castings were made from finest quality of open hearth steel—possessing all the physical characteristics of open hearth steel forgings—with a tensile strain of about 70,000 pounds per square inch and an elongation of 20 per cent., while the reduction of area did not run under 25 per cent. The weight of each shaft bracket, or strut, averaged about 11,000 pounds, while the 74-inch and 51½-inch pistons and follower rings ranged in weight from 500 pounds each to 2,500 pounds respectively. The brackets were cored out in the center for the purpose of lightening them, but this did not interfere with their strength, nor did it interfere with their being made successfully, thus demonstrating that the difficulties attending castings of irregular shape, occasioned by enormous shrinkage, has been overcome. The 74-inch pistons were made of the very best material, as they are considerably lighter than a cast iron piston would be to stand the enormous strain to which they are subjected. As an accident to this particular part of the machinery would be disastrous, the best of workmanship and material was required. The castings were made by the Penn Steel Casting and Machine Company of Chester, Pa.

LARGE SEAMLESS DRAWN TUBES.

As demonstrating the fact that perfection was sought in all the details of the boat, reference may be made here to the material used for auxiliary steam and feed pipes, and also the main waste pipes and auxiliary exhausts and wastes. These pipes are generally made from sheets of copper formed up into tubes and the seams brazed. Tubes of this description, although far from satisfactory, have been used almost universally. The tendency of such tubes to open at the seams when subjected to pressure, thereby causing incalculable annoyance and in some cases serious accidents, has induced the various governments to institute elaborate experiments. Randolph & Clowes of Waterbury, Conn., were able to furnish tubes up to 16 inches inside diameter, but only in comparatively short lengths. This firm was, however, in their intercourse with ship builders, marine architects and engineers, led to seriously consider the question of making large seamless tubes, and about two years ago, began the construction of a hydraulic machine, which is undoubtedly the most massive and powerful, and, with its tools and appliances, the most costly machine of its kind in the world. As they progressed in the erection of this machine, it was demonstrated that all their old appliances would be useless, owing to the extraordinary size and weight of all the parts and material used. The assembling of all this work delayed the firm very much in getting in a position to furnish large tubes, and it was not until about the time the Globe company was ready for the tubes for the North West that Randolph & Clowes were ready to make large tubes. Negotiations leading to the substitution of brazed tubes with seamless drawn tubes were entered into between the two concerns and it was demonstrated that the original cost of seamless drawn tubes would be in excess of that of brazed tubes. However, being convinced of the superiority of the seamless drawn tubes and of their ultimate economy to the user, the builders, without regard to the difference in cost, placed the contract with Randolph & Clowes for the large seamless drawn tubes, so that it can be said that in the construction of this boat were used the largest and heaviest seamless drawn tubes ever used in an American-built vessel, and further, that her steam and feed pipes, as well as wastes and exhausts, are made from the very best material procurable.

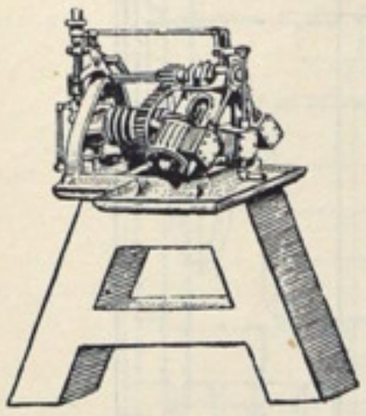
SOME ADDITIONAL PARTICULARS OF SHAFTING.

Each crank shaft is of the quadruple type, built up of eight crank slabs, eight short collared coupling shafts and four crank pins. The length over all of each crank shaft is 22 feet 8 inches; pins are 14 inches diameter in the journals and 14½ inches in the crank arms. The cranks are of the figure eight or "fiddle" type, of 21 inch centers, and are 10⅜ inches thick and 27½ inches diameter across the eyes. The short sections of shafting for coupling the cranks together are 13¾ inches diameter in the bearings, 25½ inches diameter on the couplings and 14½ inches where they go in the crank eyes.

The line shafting for each set of engines consists of five pieces—a thrust shaft 13 feet 8½ inches over all, 13½ inches to 13¾ inches diameter in bearings, 20 inches diameter on the thrust portion and 25½ inches diameter on the couplings. The first intermediate shaft is 20 feet ¼ inch over all and is of the same general diameters as the thrust shaft. The second intermediate shaft is also 20 feet ¼ inch over all, and is practically a duplicate of the first intermediate, with the exception that one coupling is 32 inches in diameter. The third intermediate shaft is 25 feet ¼ inch over all, 13¾ inches to fourteen inches diameter in the bearings, with one coupling collar 25½ inches diameter, and the other end is provided with a special coupling nut instead of the collar. The propeller shaft is 22 feet 1 inch over all, 13⅞ inches and 13¾ inches diameter and is provided with the usual wrought iron propeller nut. This makes, then, the total length of crank shaft and line shafting for each of the two quadruple expansion engines, 123 feet 6 inches. This shafting was made by the Cleveland City Forge and Iron Company.

Auxiliary Machinery.

SIXTY-FIVE STEAM CYLINDERS AND TWENTY-SIX PUMP CYLINDERS AS WELL AS A GREAT MANY OTHER DEVICES REQUIRING STEAM—REFRIGERATING APPARATUS, STEERING ENGINES, FANS, ETC.



UXILIARY machinery is greatly simplified by the abundant supply of pure, fresh water, which a lake vessel always has at command. Surface condensers, with the consequent circulating pumps, as well as much of the copper piping, are rendered unnecessary, as is also the expensive and troublesome distilling apparatus which the ocean-going ship must have. But this abundance of good water has, however, in the case of the North West at least, been the cause of increased complication and expense in the way of thousands of feet of water pipes to supply each of her half thousand passengers and crew of 150 with running water at hand in all parts of the ship, and that there is a great amount of auxiliary machinery on the boat, may be understood from the statement that there are sixty-five steam cylinders, besides twenty-six pump cylinders and a great many other devices requiring steam.

To get an idea of the many and various pieces of mechanism that go to make up the auxiliary machinery of the North West, let us take a survey of the ship. Beginning where the life of the vessel begins, in the fire room, we first come upon the ash ejectors,one in each fire room, placed in a niche of the coal bunker. The Columbian Steam Pump Company of Chicago supplied these ejectors, which consist of a small rotary type of engine coupled direct to a centrifugal pump. The latter draws from a a tank, which forms the hopper of the apparatus, the ashes mixed with water, which is supplied by a convenient sea-cock, and forces the mixture overboard through pipes leading up through the coal bunkers. At the after end of each group of boilers in the passage connecting the two fire rooms, two feed pumps are hung overhead. The George F. Blake company built these pumps, which are single barreled, double acting pumps of the Belleville type with 14 inch steam cylinder, 9 inch water cylinder and 10 inch stroke. As each of these pumps is able to feed ten boilers, even when the later are crowded, there is plenty of reserve for repairs. The extreme simplicity and solidity of the Belleville pump renders the probability of repairs being necessary remote indeed. These pumps are controlled entirely by the automatic feeding arrangement of the boiler. They are started as soon as there is 50 lbs. of steam in the main steam pipe and are not disturbed nor looked after, excepting to oil, until all fires are drawn.

Following the steam on its way to the engines we come next to the separators—one on each side of the two main steam pipes, located as near as possible to the engines. These separators, built by Mr. Belleville, are rendered necessary by the great length (over 100 feet) of the main line of steam pipe. With a short steam pipe they would not necessary, as the boilers deliver steam as dry as a lecture on psychology. An automatic drain returns the entrapped water directly to the feed tanks, thus saving the heat. The depth of water retained in the trap is easily adjusted to any desired amount, while a hand drain provides a means to get rid of the water in case of accident to the automatic arrangement. Connected directly to the separators are the pressure reducing valves, also from Mr. Belleville's shops. In size and external appearance these regulators do not compare favorably with some American types, but in perfection of regulation, simplicity and accessibility, nothing approaches them. Their range of pressure is from 0 lbs to 500 lbs.

Our next step lands us in the engine room. Here, attached to the ponderous main engines, is the reversing engine—the nerve through which the action of the big engines are controlled. Two cylinders, one steam and one hydraulic, whose pistons are on opposite ends of the same piston rod, comprise this engine. Aft of the engines, outboard the thrust bearings on either side, we find an air pump and jet condensers. The latter calls for no special remarks. The former is double vertical, with single acting air pumps, similar to those used on the new United States cruisers, except that the engines, which were built by the Geo. F. Blake Manufacturing Company, are compound 15″ and 30″ diameter by 18″ stroke. The air pumps are each 38″ diameter and 18″ stroke, have brass lining, brass piston and piston rods and were built by the Globe Iron Works Company. This type of air pump has given excellent results with surface condensers and promises to be entirely satisfactory with the jet condenser.

Between the thrust blocks are located four pumps. Two of them are ballast pumps, vertical, direct acting, duplex with 8″ steam and 6″ water cylinders by 10″ stroke, built by the Globe company. The piping for these pumps is arranged so that they can draw water out of any compartment of the double bottom, discharging it overboard or into the fire service pipes, or they can be used to fill the tanks as well. The cold water pump, which supplies the streams of water used to keep the bearings cool, is precisely similar to the ballast pumps, except in size, having only 4″ steam and 6″ water cylinder by 10″ stroke, also built by the Globe company. The other is the bilge pump of the ordinary horizontal duplex type with 8″ steam cylinder, 14″ water plunger and a stroke of 12″, built by the Hughes Steam Pump Company of Cleveland.

Abaft the engine room, in the shaft alley, is the turning engine. This consists of two inclined cylinders 7″ diameter by 6″ stroke, coupled to a single crank. A horizontal shaft placed athwartships is driven through a pair of bevel gears. A worm on each end of this shaft is by an exceedingly simple device thrown into mesh with a worm gear on the main shaft. Whenever it is desired to turn the main engines, as in making adjustments, this little engine can be made to turn it as slowly as may be required and stop where wanted. Still further aft, hung to the under side of the main deck, is the capstan engine with its two 8″ by 8″ horizontal cylinders at opposite ends of the crank shaft, driving, by means of a pair of bevel gears, a capstan on the main deck and another directly over it on the spar deck.

In the forward hold a labyrinth of tanks, pipes and pumps is found. The water service for the crew and cabin is here. A Worthington vertical duplex pump 10″ steam cylinder, 7″ plunger and 10″ stroke supplies the water. Two large tanks serve as reservoirs, one for cold water, and the other, supplied with coils of steam pipes, is to furnish hot water. This pump is under the control of a Mason pump governor and a pressure reducing valve of the same make. Safety valves provide an additional safeguard against accident to the piping. The refrigerating apparatus, in connection with which there is another Worthington duplex pump, $5\frac{1}{4}$″x$4\frac{3}{4}$″x5″, occupies most of the space here. The plant is from the De La Vergne Company of New York. The ammonia pump consists of a horizontal steam cylinder and vertical ammonia cylinder, motion being communicated by a walking beam. Condensing tanks, brine tanks, circulating pump, brine pump, lubricating pump, valves, steam traps and presure reducers fill the place.

Directly above this room, on the orlop deck, is the electric plant, which is described and illustrated elsewhere. On the main deck, near the forward hatchway, is the Globe patent steering gear. Two horizontal engines, with cylinders 7″ diameter and 6″ stroke, furnish the power for this machine. It is arranged so that a pull on a rod converts it into a powerful hand steerer.

In the extreme fore part of the ship is the windlass, another of the Globe Iron Works Company's patented devices. It is driven by two horizontal engines, 10″ diameter of cylinder by 10″ stroke, and by means of bevel gears and a vertical shaft it drives also a capstan above on the hurricane deck.

In each of the three iron deck houses, just aft the big funnels, is placed a double vertical engine, with cylinder 7″ diameter by 5″ stroke, driving two Sturtevant fans, one on either side, 54″ diameter and 21″ wide. These supply an abundance of cool fresh air to the fire holds and engine room.

The hand steering gear is all that remains. As a final precaution against accidents to tiller ropes and the forward steering gear, this arrangement built by the Edson Manufacturing Company of Boston is attached directly to the stem of the rudder.

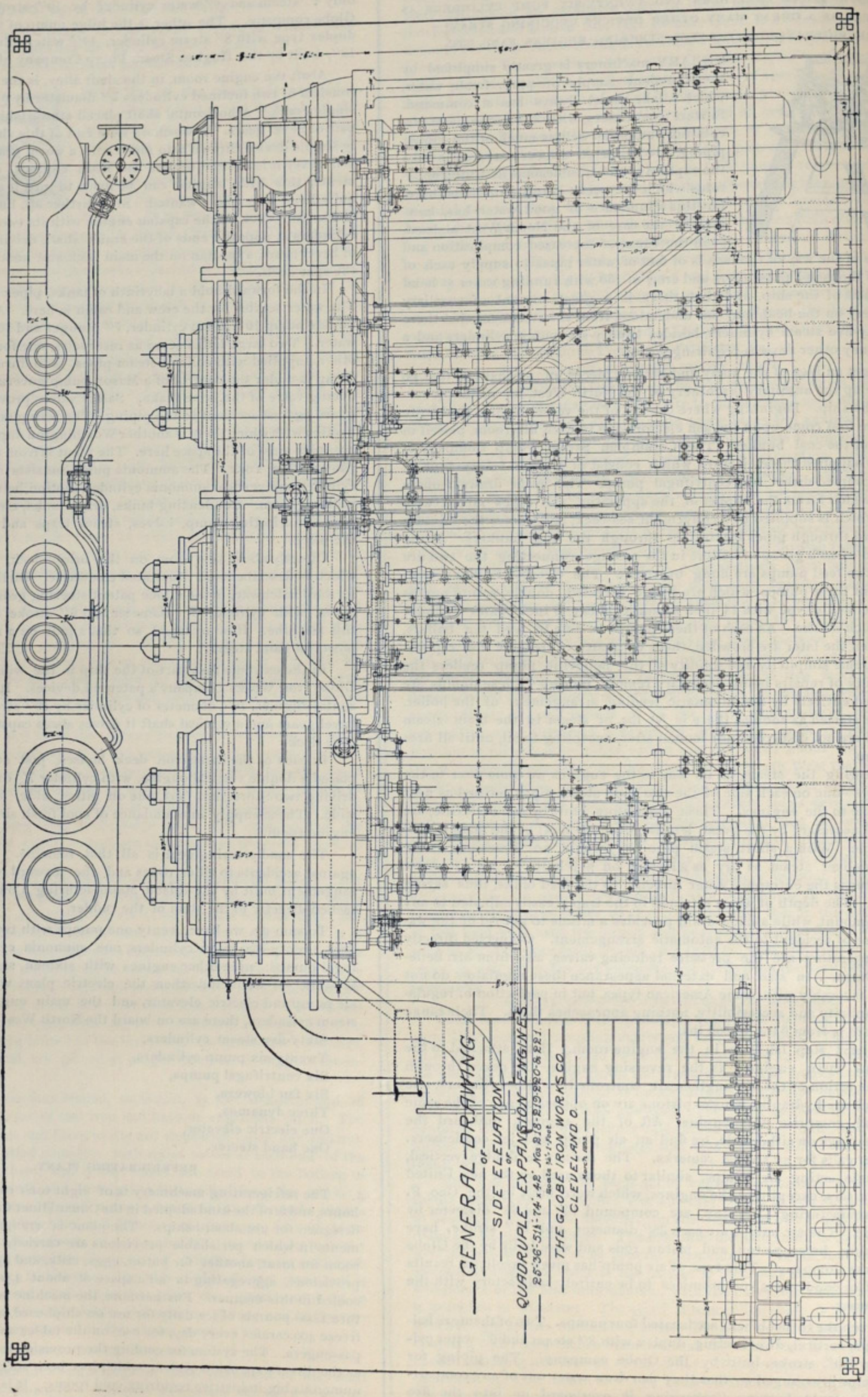
To sum up, we have twenty-one pumps with twenty-nine steam cylinders, twenty-two water cylinders, one ammonia cylinder and six centrifugal pumps; nine other engines with sixteen steam cylinders and six blowers. If we include then the electric plant with its three engines, air pump and electric elevator, and the main engines with their eight steam cylinders, there are on board the North West a total of:

Sixty-five steam cylinders,
Twenty-six pump cylinders,
Six centrifugal pumps,
Six fan blowers,
Three dynamos,
One electric elevator,
One hand steerer.

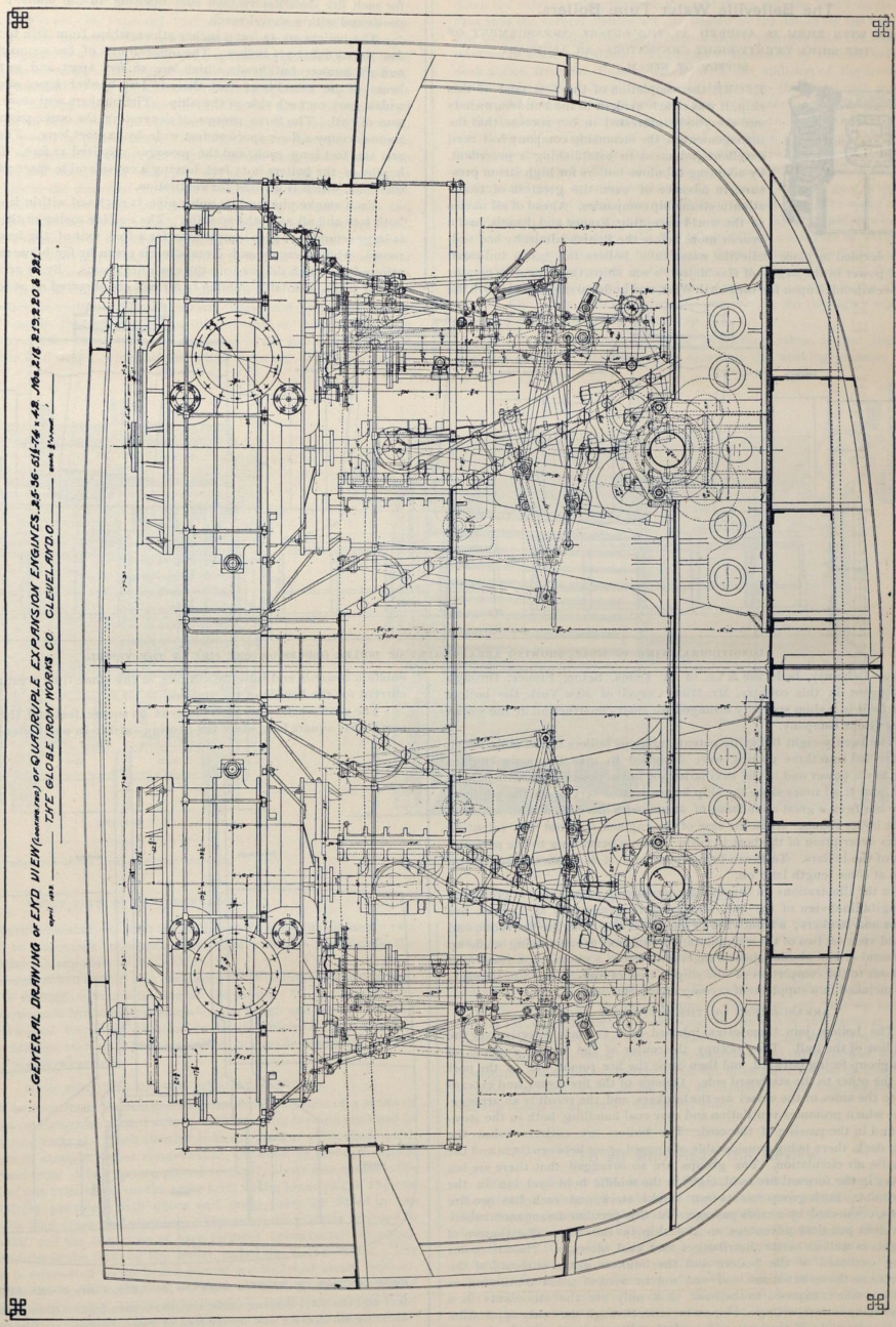
REFRIGERATING PLANT.

The refrigerating machinery is of eight tons capacity in twenty four hours, and is of the kind adopted in the Cunard liner Campania and especially designed for use aboard ships. The plant is arranged to cool all compartments in which perishable provisions are carried, there being a separate room for meat, another for butter, eggs, milk, and again another for other provisions, aggregating in all a space of about 4,500 cubic feet, which is cooled in this manner. Furthermore, the machine is arranged to manufacture 1,000 pounds of ice daily for use on shipboard, and in addition it will freeze 400 carafes every day, for use on the tables and in the staterooms of passengers. The system for cooling the provision rooms is the one known as the direct expansion system, which has been successfully introduced in numerous big industries requiring cold rooms. It is, of all the systems in existence, the most efficient and the most economical, and has been thoroughly tested.

DRAWINGS OF THE 7,000 HORSE POWER QUADRUPLE EXPANSION ENGINES OF THE STEAMER NORTH WEST.



GENERAL DRAWING SHOWING SIDE ELEVATION.

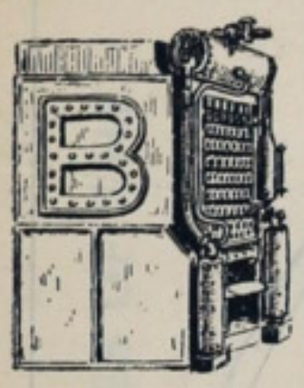


GENERAL DRAWING or END VIEW (looking aft) of QUADRUPLE EXPANSION ENGINES. 25-36-51½-74 x 48. Nos 218 219 220 & 221
built 1903 THE GLOBE IRON WORKS CO. CLEVELAND O.

THE TWO ENGINES SHOWN IN MID-SHIP SECTION.

The Belleville Water Tube Boilers.

SUCCESS WITH THEM IS ASSURED AT THE OUTSET—ARRANGEMENT OF THE SHIP'S TWENTY-EIGHT GENERATORS—AN ABUNDANT SUPPLY OF STEAM.



BEFORE the completion of the first trial of this ship, it was clearly evident to the builders, owners and everybody interested in her success, that the management of the steamship company had used excellent judgment in establishing a precedent, by adopting tubulous boilers for high steam pressure, in advance of even the greatest of transatlantic steamship companies. Ahead of all navies of the world excepting France and Russia, and a year or more before the British admiralty had suddenly decided to place Belleville water tube boilers for 53,000 indicated horse power in the largest of Her Majesty's war ships, this type of generator had been decided upon for the North West, and under arrangements with the firm of Delaunay, Belleville & Co. of St. Denis, Seine, France, through their agent in this country, Mr. Miers Coryell of New York, the boilers were built in a shop specially arranged for their construction at the works of the Globe company.

The twenty-eight Belleville patent tubulous boilers in the ship, which are divided into three groups, were designed to give the main engines 7,000 horse power and to the auxiliaries 500 horse power more, with natural draft, and at all times since the ship began regular service on the 5th inst. there has been a great abundance of steam, with no difficulty of any kind in the boiler rooms. As in the case of the engines, it is not the intention in this description of the boat to cover matters pertaining to the performance of the boilers. Tests are being made and it is expected to refer to them at some length later on.

In the illustrations on this and accompanying pages there is presented a longitudinal view of the hull, showing arrangements of all boilers, fire rooms and bunkers; a front view of one generator from the fire room, and an end view of two of the generators, the different groups being made up of several distinct boilers joined together. From a photograph taken just previous to the completion of the ship, a view of one of the fire rooms is also included in a supplement accompanying this issue.

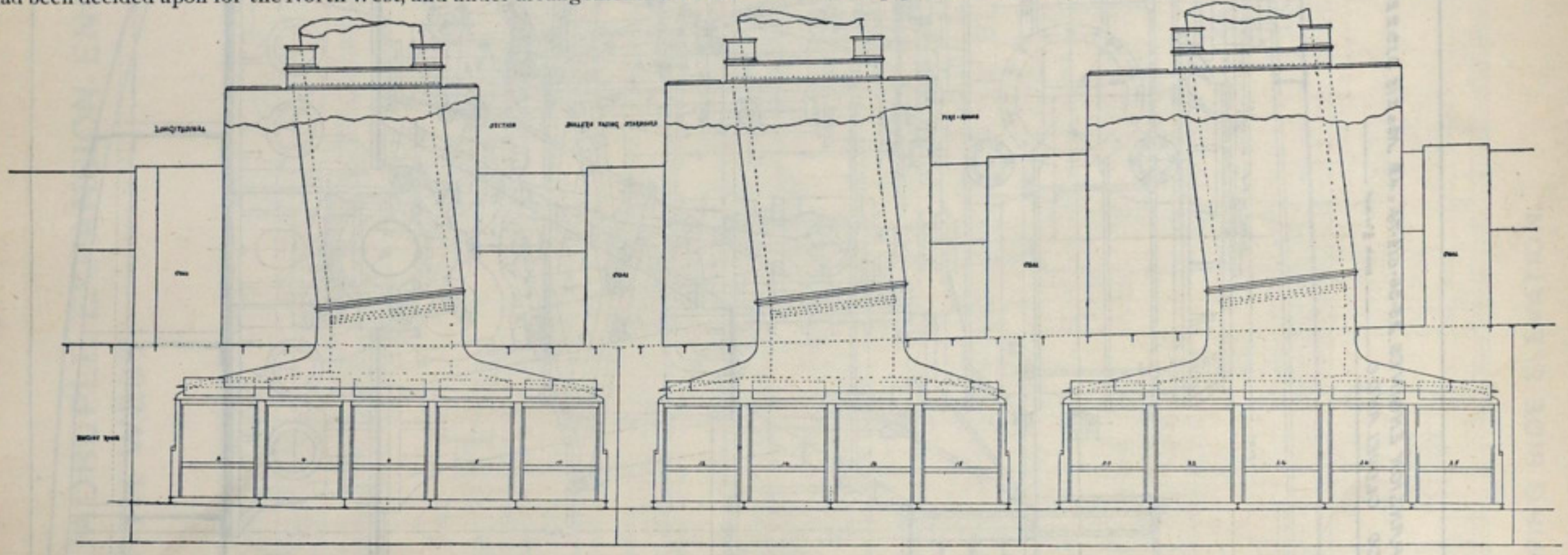
ARRANGEMENT OF THE DIFFERENT GROUPS.

The boilers join themselves inboard, back to back, directly over the keel line of the hull. They occupy the center of the vessel, one-half of each group facing outward, and then come the fire rooms, one to the port and the other to the starboard side. Outside of the fire rooms, and extending to the sides of the vessel are the bunkers, and the result is an arrangement which promotes ventilation and easy coal handling, both in the stowage and in the passing of the coal. The boilers are entirely below the main deck, there being considerable of unused space between them and the deck for air circulation. The groups are so arranged that there are ten boilers in the forward fire hold, eight in the middle hold and ten in the after hold. Each group has its own smoke stack, and each has two fire rooms, connected by a cross passage. In this peculiar arrangement there is evident practical advantage to the ship in the better distribution of weights as well as better distribution and coal stowage. The fire rooms being outboard of the boilers and the bunkers again outboard of the fire rooms, these latter are cool and not in need of great ventilation, as only one side is exposed to the heat. Not only are the attendants in a better temperature with good air to breathe, through the ready application of a system of draft from blowers on deck, adjacent to the stacks, but the handling of coal by the firemen is from the bunker direct to the furnace, for each fire door has its own coal opening in the bunker directly opposite and within shovel reach.

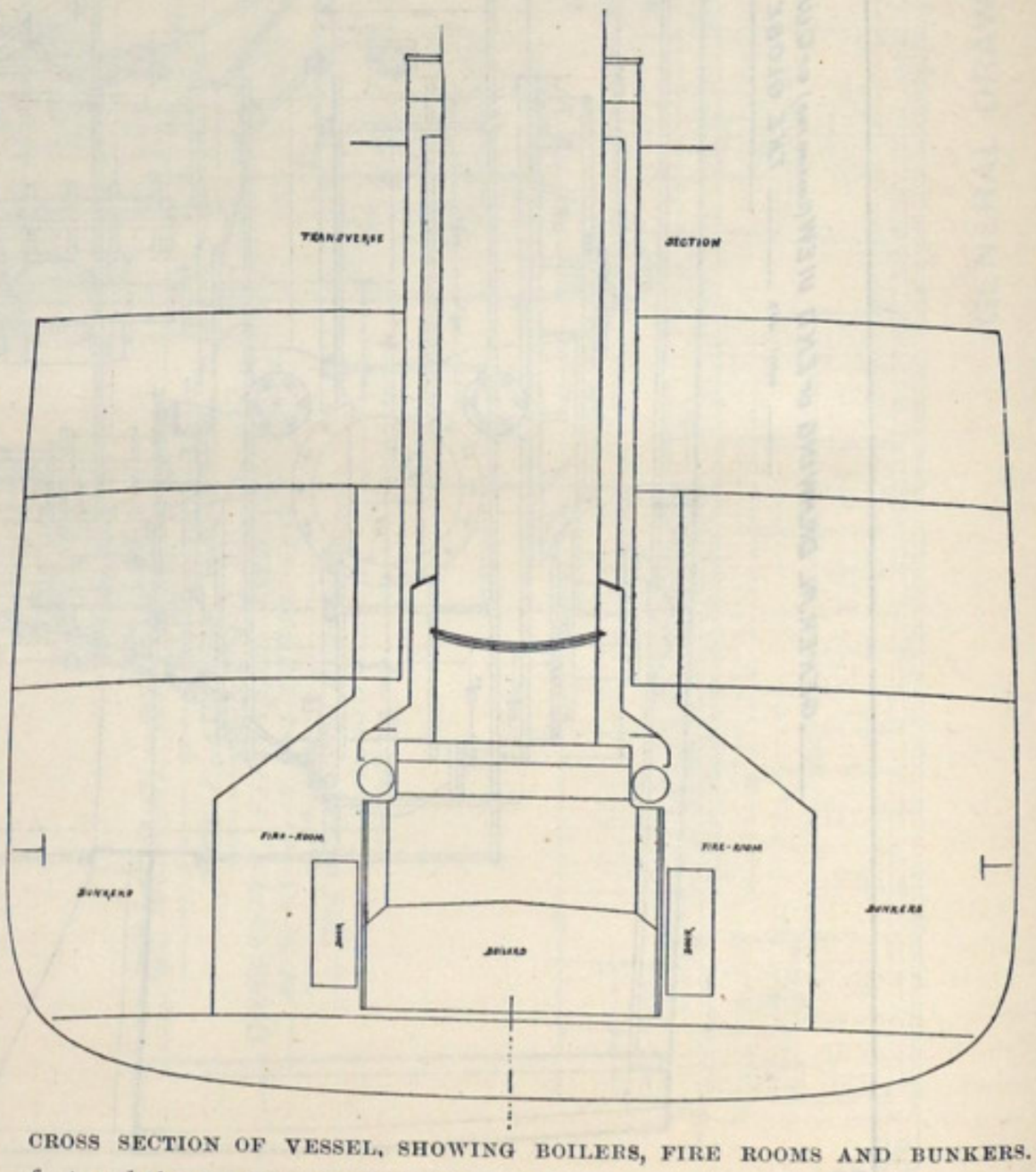
The boilers are 12 feet 9 inches athwartships from face to face and the fire rooms 6 feet 7½ inches. The outer limits of fire rooms are the fore-and-aft bunker bulkheads, which are 26 feet apart, and as the extreme beam of the vessel is 44 feet, there is left bunker space of 9 feet at the widest part on each side of the ship. The bunkers will store about 1,000 tons of coal. The three groups of generators, the cross passages and fire rooms occupy a floor space 26 feet wide by 124 feet long. The two fronts are 112 feet long each, and the passages required 12 feet. The extreme height of the boilers is 11 feet, leaving a considerable space unused under the deck, which is utilized for ventilation.

Each smoke pipe and its outer pipe is enclosed within iron bulkheads both fore and aft and athwartships. The outside casing of the smoke pipe is large enough to give ample area for a free exit of the heat of the fire rooms, while a supply and circulation is given by fan blowers previously referred to, which deliver into the open fire rooms. By an arrangement of the air pipes, a suitable number of air jets are directed so as to induce circulation towards and into the ash pits, at the same time creating a cooling current for the benefit of the stokers.

The grate surface of each boiler is 29 square feet and the total grate surface 812 square feet, while the heating surface in one boiler is 920 square feet and the total heating surface 25,760 square feet. Other particulars are: Heating surface for one square foot of grate surface, 31; pressure allowed, 267 pounds per square inch; total weight of boilers with water, 400 tons; height from fire room floor, 11 feet 4 inches; grates, "Aetna," shaking.



LONGITUDINAL VIEW OF HULL, SHOWING ARRANGEMENT OF BOILER GROUPS ON ONE SIDE OF THE VESSEL.



CROSS SECTION OF VESSEL, SHOWING BOILERS, FIRE ROOMS AND BUNKERS.

NOT A NEW BOILER.—ITS IMPROVEMENTS.

In this ship it may be expected that the advantages claimed for the boilers will be fully shown, as they are for the first time fitted to quadruple expansion engines in a large vessel, and a special opportunity is at hand for showing the economy of their application over the Scotch boiler, which, it is claimed, has limited the pressure and delayed expansive engines at the triple type. Their application to the North West can hardly be considered in the light of an experiment, on the claim that they have not before been used for high power in this country. The boiler was invented as far back as 1849, and as a result of numerous improvements that have since been made upon it, the attention of shipping and ship building companies, as well as leaders in the navies of maritime countries, is now directed to it. Belleville boilers are now in use in French naval and merchant vessels and in English and Russian naval vessels of about 250,000 horse power in all, while there is in course of construction in France and England naval vessels of about 75,000 horse power, that are also to be fitted with this type of generator. In this country there are a few vessels considerably smaller than the North West that are fitted with the boilers.

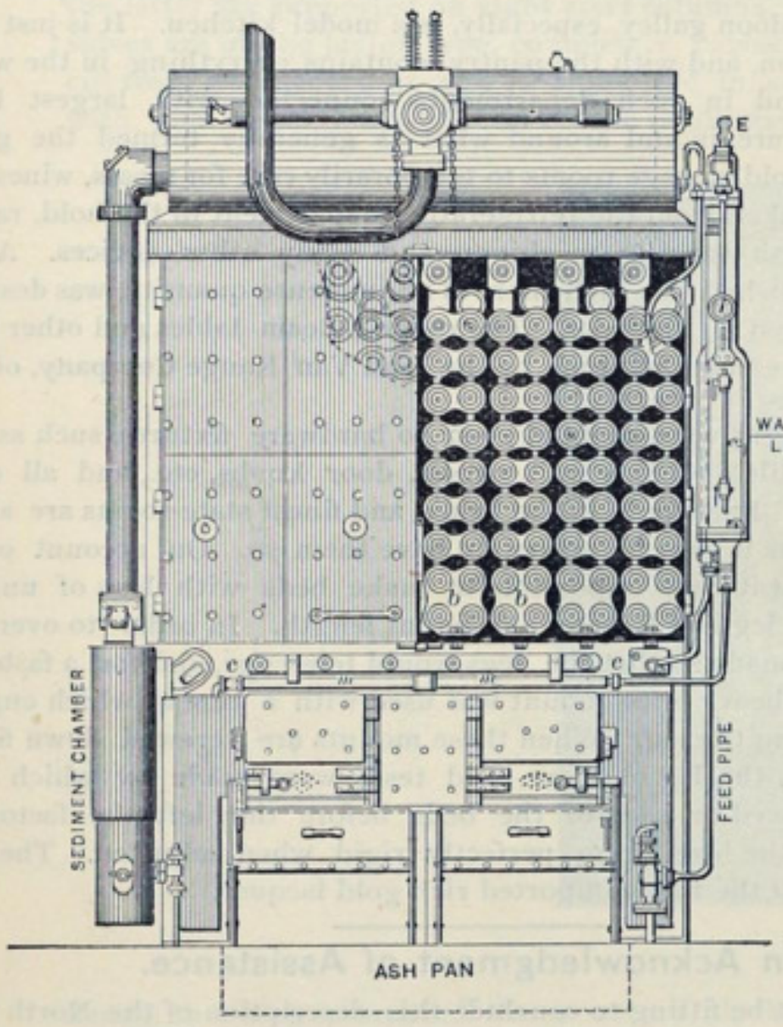
The Belleville system embraces several important improvements in boiler attachments that are applied in this steamer as in all others now under construction. These include a separator of the steam and water; a purifier of the feed water, which deposits lime or other calcareous matter into a sediment chamber, so that the feed water enters the elements in a pure state; an automatic regulator of the feed water by which only the water vaporized is supplied to the boiler.

The present construction also embraces the inventor's system of constant test of strength of material and of the joints. All material is subjected to 800 pounds hydrostatic pressure in the rough and when machined and jointed a final test of 650 pounds—to be absolutely tight at this last test. The fittings, such as valves, cocks, etc.. are made especially for the high boiler pressure carried.

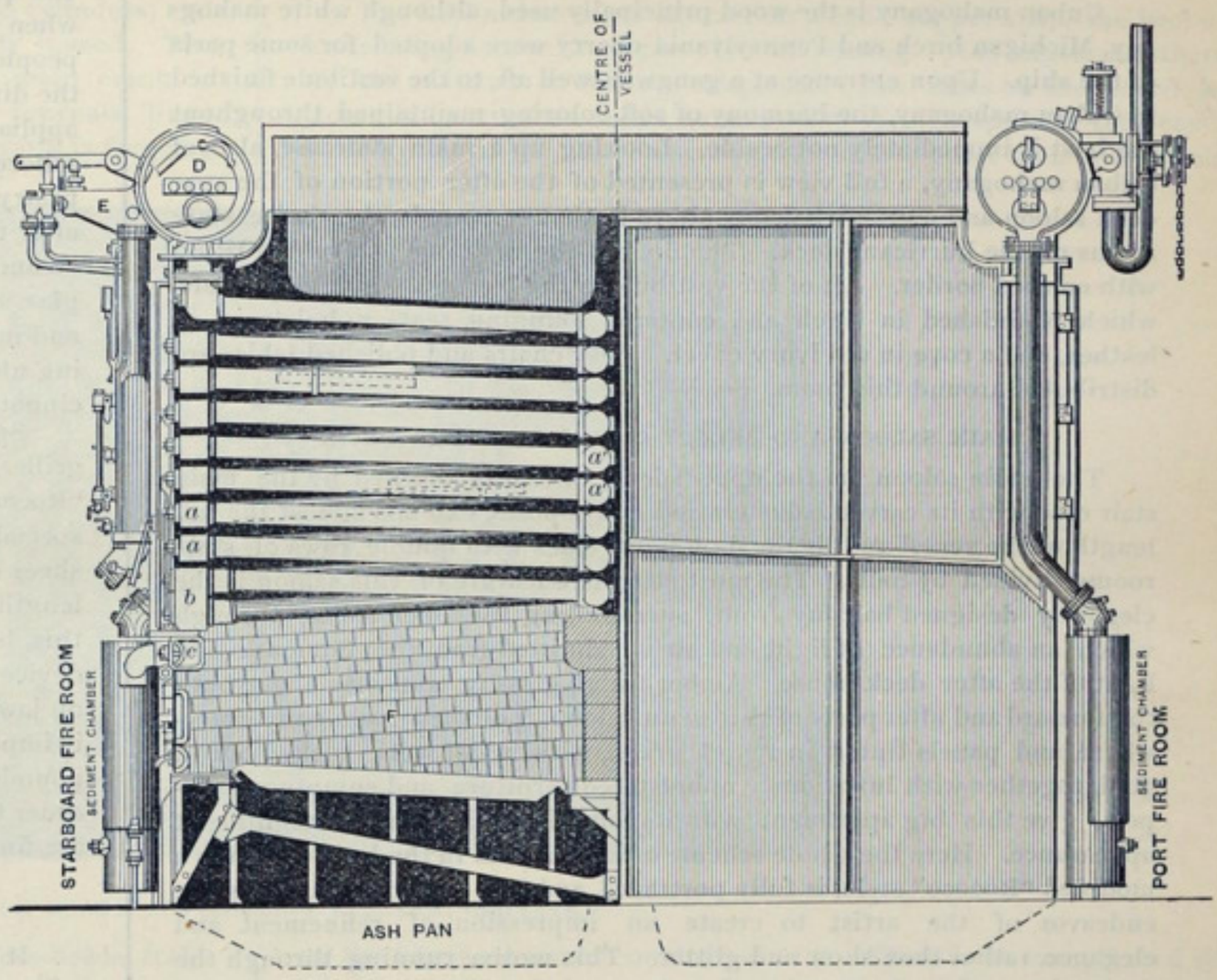
MAIN FEATURES OF THE BELLEVILLE SYSTEM.

As will be seen from the illustrations the boiler consists of a series of sets of tubes or elements, placed side by side over the fire and enclosed in non-conducting casings. Each element is in the form of a flattened spiral, and consists of straight tubes connected at the ends by junction caps of malleable cast iron. The caps are placed vertically above one another, the upper end of one tube being on the same level as the lower end of the one above it. Holes provided with doors and cross bars, are fitted in the front caps for inspection and cleaning. The tubes are slightly inclined to the horizontal, and the lower cap of each element is connected to a horizontal cross tube at the front of the boiler, called the feed collector. The upper tube is connected to the lower part of a cylindrical steam receiver, placed outside the boiler casing. A vertical circulating pipe, also placed outside the casing, conveys the down current to a mud drum, placed at the base of the boiler, the upper part of which is connected to the feed collector. The feed water is delivered into the steam receiver at the end remote from the inlet of the down-cast pipe, passes along the receiver bottom down the external pipe, through the mud drum into the feed collector, and thus into the several elements to be heated by the action of the fire on its way upwards through the tubes, from which it emerges into the receiver a mixture of water and steam. The latter is separated by suitable baffle and dash plates from the former, which, with the addition of the fresh feed-water, again passes along the receiver bottom to the down-cast pipe and follows the same course as before. The feed water is supplied by pumps of the duplex direct acting type, and its admission to the receiver is regulated by self-acting gear of novel and ingenious character. The water stand-pipe is connected to the top and bottom caps of the outside element, and in it is pivoted a float, which falls and rises with the level of the water in the stand-pipe, opening or closing, by means of suitable gear, a balanced feed check valve of special design fitted on the receiver. The water level in the stand-pipe is thus maintained at a constant height, which when the boiler is under pressure with the tubes full of a mixture of steam and water, is on a level with the fourth tube from the top. The forced circulation of the water is caused by the difference of density between the water in the down-cast pipe and the mixture of steam and water in the element tubes. The steam, after leaving the receiver, is led through a separator provided with a self-acting steam trap.

One of the main features of the Belleville system is that the boiler pressure should be considerably in excess of the working pressure of the engine, to which it is reduced by means of suitable reducing valves. This ensures economy and the purification of feed water. The reason for M. Belleville's preference for very high pressures is that, besides increasing the economy of evaporation, they facilitate the separation of the earthy salts contained in the feed water. The solubility of these salts decreases with the increase of the temperature of the water, and here we have the reason for introducing the feed water at the end of the receiver remote from the down-cast pipe, and for leading it through the entire length of the receiver. The salts, principally sulphates and carbonates of lime, are precipitated and fall to the bottom of the sediment chamber or mud drum, whence they are blown off as often as required. The time required for raising steam is, of course, extremely short.



FRONT VIEW OF ONE GENERATOR FROM FIRE ROOM



SECTION THROUGH CENTRE OF ONE GENERATOR ½ END VIEW OF A GROUP

FRONT VIEW OF ONE GENERATOR. END VIEW OF TWO GENERATORS.

To all who Read the Review.

Many readers of this issue of the REVIEW are people who do not see it regularly. Although published on the lakes and primarily devoted to lake transportation, its illustrations and weekly collections of information keep a reader informed of the latest practice in shipping and ship building all over the world. Unbiased contemporaries will agree that the REVIEW is the best marine publication in the United States; they will agree, at least, that no other marnie publication has ever shown capability of producing an edition equal to the present number of the REVIEW. These few sentences are written merely for the purpose of emphasizing the suggestion that you subscribe. The paper is $2 per year. MARINE REVEIW, 516 Perry-Payne Bldg., Cleveland, O.

A Grand Interior.

RICH MAHOGANY FINISH, MODEST COLORING AND ELEGANT CARVING—ALL FURNISHINGS SPECIALLY DESIGNED FOR THE SHIP—THE DECORATIONS.

No expense has been spared to make this ship equal in point of comfort and elegance to the finest transatlantic liners, but in all the decorations and furnishings there is none of the gaudy effect so often found in public places. The rich mahogany finish, modest coloring and elegant carving, as well as carpeting, upholstery, and furnishings of all descriptions in cabins and state rooms devoted to accommodation of passengers, are all of the kind found in the most elegant and costly modern American homes. During the early stages of construction, it was decided by the builders and owners to employ art decorators for the interior work, and the whole scheme of decorations and furnishings was turned over to Mr. Abner Crossman of the firm of Crossman & Lee, Chicago. As a result, there is no stock work about the ship. Everything under the head of furnishings was designed especially for the boat, even to locks for stateroom doors. About 2,200 yards of carpet—Wiltons, velvets and other costly makes—were manufactured upon special order, and the napery, inwrought with the names of the company and the boat, was made in Belfast, Ireland. The same care was used in the selection of everything else about the ship, the aim in every way being to secure the best.

Cuban mahogany is the wood principally used, although white mahogany, Michigan birch and Pennsylvania cherry were adopted for some parts of the ship. Upon entrance at a gangway, well aft, to the vestibule finished in Cuban mahogany, the harmony of soft coloring maintained throughout the boat is immediately noticeable. Looking up a main staircase, also of Cuban mahogany, a full view is presented of the after portion of the spar deck saloon and a grand balcony above it that surrounds the choice state rooms on the hurricane deck. The floor of the vestibule is a rubber tiling with colored border. Aft of the vestibule is the bar and gentlemen's cafe, which is finished in birch and contains lounging seats upholstered in leather, and a cove in old ivory effect. Easy chairs and polished tables are distributed around this room.

MAIN SALOON AND SELECT CABINS ON UPPER DECK.

The main saloon on the upper deck, which is reached by the main stair case with its carved balusters and newel posts, extends almost the full length of the vessel and is lined on both sides with double rows of state rooms, divided by halls. The most attractive feature of this saloon is the elegantly designed balcony front, surrounding the open space, through which an abundance of light and air is admitted from the immense skylight of the after deck house. Amber tinted glass in transoms above both the forward and after parts of this main saloon, polished mahogany everywhere, and panels tinted in russet green, with relief work picked out in gold, together with luxuriously upholstered furniture and sumptuous carpets, give this big apartment with its long sweeping lines a magnificent appearance. Here the whole scheme of decorations in the boat, which is a modified "Rococo" style, is fully portrayed, and it is evident that it was the endeavor of the artist to create an impression of refinement and elegance, rather than show and glitter. This motive running through the design in wood-work, metal-work, glass, upholstery, etc., may be likened to the skilled pianist playing many different tunes on a single instrument. On the port side of this deck are located toilet and bath rooms for ladies, while on the starboard side are the bath rooms and lavatories for gentlemen, the latter having a marble tiled floor and painted plate glass partitions and back walls. The barber shop is also on this deck, next forward of the gentlemen's lavatory.

Probably the most attractive part of the boat is the ladies' saloon in the after part of the hurricane deck. Over the main saloon aft is a galleried saloon, surrounded by a single tier of state rooms of extra size, with windows opening on the promenade deck. The forward part of this saloon widens into a spacious ladies' music room and library, 26 by 29 feet. Out of this room are doors that lead to the promenade deck, and there is also a stairway to the main saloon below. An open grate in a cozy retreat at the after end of this saloon is a novel and beautiful feature, but the most striking indication of the artist's desire to give this part of the boat a parlor like appearance is the furnishings of the larger space forward. Here there are luxurious easy chairs and divans, book cases and writing desks, a baby-grand piano and ornaments of various kinds. Another saloon forward on the hurricane deck, has also in its center a light and air well extending over the forward portion of the main saloon, and is surrounded by a number of state rooms of the special class, furnished with brass bedsteads, upholstered seats, etc. The finishing of this saloon is in primavera from Mexico and the color of carpeting a grayish blue.

DINING SALOON—OTHER ATTRACTIVE FEATURES.

The smoking room on the hurricane deck, forward of the saloon just described, is 12 by 26 feet and is made unusually attractive by the unobstructed view, forward and on both sides, to be obtained from its windows. This room has a tessellated floor, is finished in white mahogany and the upholstering is of a dull terra cotta leather.

From the extreme forward end of the main saloon a staircase of solid mahogany leads to the dining room. Part of it is elegant in hand carving. The newels are finely modelled male and female figures, executed by Richard Bock of Chicago, who did all of the decorative work on the Mines building at the World's Columbian Exposition. An immense polished French plate mirror reflects the attractiveness of the dining room immediately upon this staircase being reached. The dining room will accommodate about 150 persons. Under the glare of many electric lights that stud the ceiling and sides, this very large room presents a brilliant appearance. Side boards and tables are of Pennsylvania cherry and the sides and ceiling are enameled white and gold—just a little of the latter; sufficient but not overdone.

In all ordinary state-rooms there are recesses for hanging clothes and a sufficiency of room, while the large parlor rooms with alcoves containing baths, have two brass beds and two Pullman berths, as well as large upholstered lounges. Electric lights with ground glass globes and electric call buttons connecting with the clerk's office are a part of the fixtures in all rooms, and passengers on the boat can at all times secure anything that may be had in a first-class hotel.

IN THE GALLEYS AND PANTRIES.

As may be seen from an examination of the plans of this ship, nearly all of the main deck forward of the engines is given up to dining rooms and quarters for the preparation of food. Of course this is not surprising when it is considered that the boat is licensed to carry, including crew, 800 people. The saloon galley, especially, is a model kitchen. It is just aft of the dining saloon, and with the pantry contains everything in the way of appliances found in such departments connected with largest hotels ashore. There are, in and around what is generally termed the galley, pastry rooms, cold storage rooms to temporarily care for meats, wines, etc., after they are taken from the refrigerating department in the hold, ranges, steam tables, dish-washing machinery and many other devices. All the glassware and dishes, of which there is an immense quantity, was designed and manufactured for the boat. The ranges, steam tables and other cooking utensils were manufactured by the John Van Range Company, of Cincinnati.

Special designs were adopted even to hardware fixtures, such as door grilles, stair grilles, balcony rail panels, door knobs, etc., and all are of "Rococo" style. Brass beds in the bridal and finest state-rooms are also of special design, as it was necessary to have them so. On account of the sheer of the boat it was impossible to make beds with legs of uniform length, as every leg had to be of a different length. In order to overcome this, beds were made so that the legs would telescope, and for a fastening device a simple heavy brass mount was used with a thread which engages on jaws, clamping the leg. When these mounts are screwed down firm it is impossible for the leg to move, and tests were made by which 2,000 pounds were placed on each of the beds before they left the factory, in order to insure the beds being perfectly rigid when adjusted. The beds are finished with the finest imported rich gold lacquer.

In Acknowledgment of Assistance.

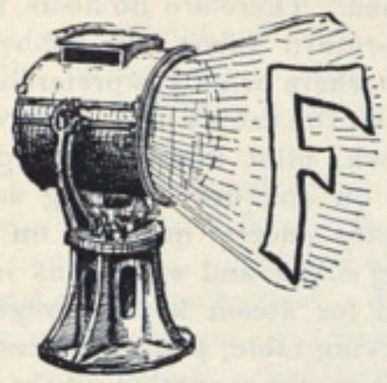
It would not be fitting to conclude this description of the North West without a word of thanks to the management of the Globe Iron Works Company and the steamship company, who have greatly assisted us in the work. A portrait group, taken on deck while the boat was under construction, is reproduced on another page. It contains likenesses of nearly all the gentlemen who have been in charge of important work on the boat. Chief among these are General Manager John Pankhurst and Secretary Luther Allen of the Globe company, builders of the boat, and Messrs. John and F. P. Gordon, manager and assistant manager of the Northern Steamship Company. Others in this group are: A. U. Sheldon, naval architect of the Globe company; Miers Coryell, representative of the owners of patents on the boilers; Abner Crossman, who was in charge of the decorations and furnishings, and Frank E. Fisher of the electric company that equipped the boat with a lighting plant. Messrs. Goodrich, Hurson and others who appear in the picture were inspecting the boat at the time, and in this way happen to be among the owners and builders.

There are two gentlemen missing from this group to whom the REVIEW is especially thankful for assistance. One of these is Walter G. Miller, constructing engineer for the Globe company, and the other is Mr. G. L. H. Arnold, who came to Cleveland with Mr. Coryell, and who was engaged on the design and immediate supervision of boiler construction.

The excellent reproductions of the interiors and other portions of the boat are printed from enameled copper plate photo-engravings. Primarily first class photographs are required, and these were executed by J. B. Clark, Cleveland, Ohio, who has taken nearly one hundred views of the boat and machinery since her construction was commenced. The engraving was produced by the National Photo-Engraving Co., also of Cleveland. The large supplement of the North West showing her approaching on the quarter has been pronounced to be the finest photographic view of a steamer published. The decorative view at the top, shows Bois Blanc island at the mouth of the Detroit river, the prettiest spot between the two lakes.

Electric Lighting Equipment.

THREE SETS OF DIRECT CONNECTED TRIPLE EXPANSION ENGINES AND DYNAMOS OF 1,200 SIXTEEN-CANDLE-POWER-LIGHT CAPACITY—ELEVATOR, SEARCH LIGHT AND SIGNALING APRARATUS.



FEATURES of interest in this steamer, even to the casual observer of progress in ship building, are numerous, but in no part of the vessel is improvement more clearly represented than in her electric lighting equipment. The work was executed by the Fisher Electrical Mfg. Co., of Detroit, a firm that has equipped United States gun boats, vessels of the treasury department and passenger and freight boats on the lakes to the number, in all, of about 100, within the past few years. The dynamo room is located forward on the main deck, entirely apart from the engine room, and occupies a space by itself. The plant is divided into three units, each consisting of a vertical, direct-connected, triple expansion engine and dynamo. The units are of 400 sixteen-candle-power light capacity each, and develop an E. M. F. of 110 volts at 300 revolutions per minute. A separate condenser is supplied and connected to the electric lighting engines, suppressing entirely the noise occasioned by high pressure exhaust. Bedplates of engines and dynamos are cast in one piece, as are also the cylinders, and the latter are supported on eight steel columns, thoroughly braced. The valves are of the piston type, completely balanced. The main crank is cut from a solid forging and is supported in self-oiling journals, lined with gun metal. On one end of the triple expansion crank is forged a flange, to which is secured the armature shaft. The cross-heads, stubs and all moving parts of the engine are made of the highest grade of box metal. The engines are equipped with automatic relief valves and thoroughly protected with oil guards. The dynamos are of a multipolar type, the armature winding being so arranged that but two sets of brushes are necessary. Each dynamo terminates on a switch board in a main line switch, and the system of switching is so arranged that the lighting of the entire boat may be thrown on one machine, provided the lamps in use do not exceed the capacity of the dynamo, or the load can be divided equally and automatically among them.

About 120,000 feet of moulding was used throughout the installation. The wiring scheme adopted by the United States navy is followed, but two sizes of wire being employed—one size for mains and another for branches. The branches are taken from junction boxes, which form part of the fixtures, and a fusible cut-out is inserted in each pole of each branch. This practice not only secures absolute safety, but reduces complications and simplifies the system of fusing, two sizes only being used—one diameter of fuses for branches and a larger diameter for mains. All wires are enclosed in heavy mouldings, which are secured by machine screws to the steel decks. A separate hole is drilled in the steel beams for each wire, and the holes bushed with heavy rubber tubes. With this method, the moulding is entirely protected from mechanical injury and will not warp out of shape.

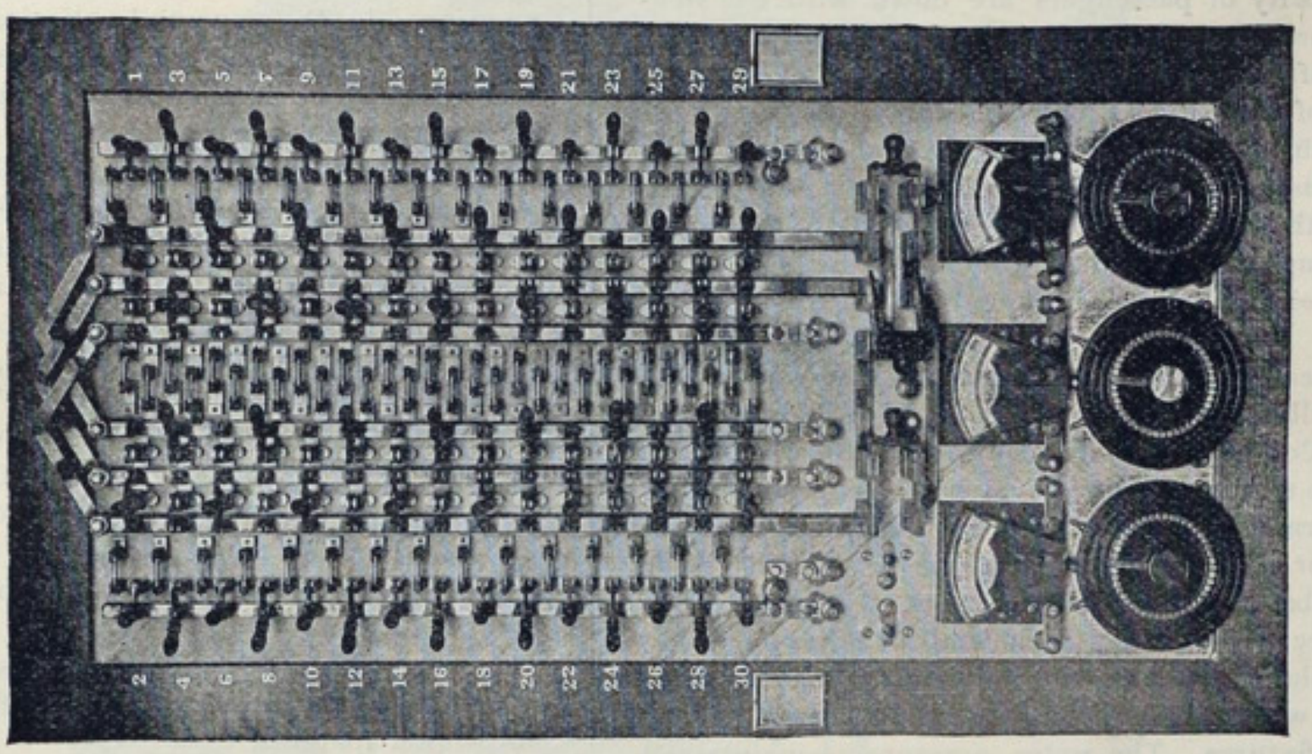
LIGHTS AND ELECTRICAL ATTACHMENTS IN STATE-ROOMS.

As noted in the description of saloons, dining room and other parts of the ship occupied by passengers, the light from clusters and hundreds of single lamps produces a grand effect in the ship. State-rooms are lighted by sixteen-candle-power lamps, enclosed in ground glass globes, and these lamps are lighted and extinguished by a switch adjacent to the birth. Panels in the main saloon running parallel with the state-rooms are also fitted with sixteen-candle-power lamps, enclosed in ground glass globes. This same mode of lighting is followed in other departments, but the style of fixtures is, of course, somewhat varied. Particular attention has been given to lighting the boiler and engine rooms, which contain lights in numbers almost equal to the main cabins, and the big propelling engines are lighted in every part. Electric signal lights of 100 candle-power each are connected to an automatic alarm attachment in the pilot house. In case a lamp is extinguished by accident or otherwise, it rings an alarm bell in the pilot house and also lights a lamp, notifying the officers in charge immediately that a lamp has been extinguished. Each state-room is connected to the clerk's office by means of an electric bell, the buttons for which are placed adjacent to the berths.

SWITCH-BOARD CONTROLLING ELECTRIC CIRCUITS.

All the circuits throughout the ship are controlled by a thirty circuit switch-board, located in the engine room. The syetem of wiring is so planned that the fuses are located at two points only—on the switch-board and in the base of the lamps. In case a fuse blows or a circuit gives out, it is necessary to examine but two points, the switch-board or the base of the lamp. The switch-board is so arranged that the entire load is thrown on one dynamo, or divided equally and automatically among the three, or one machine can be used for the search lamp, only the others operating the balance of the boat circuits. The rheostats are located at the base of the board and the ammeters directly over them.

The heel switches are all cast on a solid copper strip, the heel of the knife being secured by a pivot to each casting. It is impossible, therefore, for the switches to become misplaced. The fuses on the board are enclosed in heavy glass tubes, supported in spring clips, and they can be renewed without the use of a screw driver or any other tool. All the circuits on the board are located on the face of it. There is no complicated system of wires and circuits at the rear. The switching mechanism and all the instruments are mounted on a marble panel 40½ inches wide by 81 inches high and 1½ inches thick, all enclosed in a heavy oak frame.



SWITCH BOARD CONTROLLING ELECTRIC CIRCUITS.

ELECTRIC SEARCH LAMP OF 100,000 CANDLE POWER.

The steamer's search lamp is 7½ feet high, and the upper structure is built entirely of thin sheet steel mounted on a cast bronze base. The saddle, supported on the cast bronze base, carries the cylinder enclosing a 30-inch Mangin lens and the automatic lamp mechanism. The carbons used in the lamp are 1¼ inches in diameter, and the initial candle power at 110 volts is 100,000. The lamp is equipped with a flashing damper. The parallel rays from the Mangin lens are passed through the diverging lens on the front of the cylinder. The diverging lens broadens the rays or increases the area covered by the lamp. The lamp, however, can be operatedwith or without the diverging lens. By means of a controlling switch located on top of the pilot house, the lamp is controlled electrically in all directions. This switch is under the immediate control of the captain and the lamp can be maneuvered either horizontally or vertically.

Search Light Regulator.

The electric hoist is a very handy feature of the electrical equipment of the boat. Operating between the main deck and the hold, where the ice boxes and the ice machine are located, is an electric elevator with a capacity of 3,000 pounds. This elevator is operated by an electric hoist, as shown in an illustration on another page. In moving the elevator, it is simply necessary to throw the circuit on at the terminal points. If the circuit is closed while the elevator is on a level with the main deck, it is lowered automatically to a level with the ice boxes, where it is stopped automati-

cally. By again closing the circuit the elevator is returned to the main deck.

ELECTRIC SIGNALING APPLIANCES.

The latest approved appliances known on ship board have been selected for signaling between engine room and pilot house. By the pressure of a button in the pilot house and in several different places on the bridge the steam whistle is blown, and by setting an electrical switch, intended for use during thick weather, the fog signal, a blast of ten seconds duration in every minute, is blown continuously. A clock-work device in the pilot house registers on a continuous strip of narrow paper the time and duration of every blast of the whistle, no matter for what purpose it is blown, so that at the end of each trip made by the boat an absolute record in this regard is turned into the office of the company.

Model Water Supply and Sanitary Plant.

A SYSTEM OF HOT AND COLD WATER APPLIANCES AND STEAM HEATING APPARATUS UNEQUALED IN ANY CRAFT AFLOAT—ABSOLUTE PROTECTION AGAINST FIRE.

No craft afloat has a system of hot and cold water supply, or provisions for the disposal of waste, that at all approaches the equipment of the North West in this regard. With the advantages offered by unlimited fresh water, the owners of the vessel have spared no expense in putting in a system for water supply and sewerage that approaches the sanitary engineer's idea of a model city. Full $20,000 has been expended on this plant alone, and unlike even the great Cunard liners Campania and Lucania, there are no cabinets in the state-rooms with limited water supply and the accompanying unpleasant features that follow the first day of a voyage, when the great majority of passengers are down with sea sickness. Running water at a pressure greater than that of probably any city service on the lakes is one of the grand features of the boat. The possibility of fire in a steel boat of this kind is not, of course, an important question, but to meet even the slight possibility of such an accident, the water pressure, constantly maintained throughout the ship, is supplemented by a system of valves with hose attachment in every part, that does away with the danger of pumps not working when most required and makes the vessel almost absolutely secure from danger of the slightest loss through fire.

The systems of steam heating, supply of water and the disposal of waste were designed especially to meet the requirements of the managers of the Northern Steamship Company, who decided to abandon all that was objectionable in the systems so long in use on steamers for something more in keeping with modern advancement ashore. The arrangement of the water supply provides for a supply under pressure to over 200 wash basins, about fifteen bath tubs, thirty-six water closets, ten urinals, five sinks, and also for fire protection, washing decks and for other purposes. Hot and cold water is furnished at all bath tubs and sinks and at the dish-washing machinery and all wash basins in the general lavatories, and cold water only to all other fixtures. The water pressure is maintained automatically at about fifty pounds per square inch, and on the fixtures where a less pressure is wanted, provision is made that reduces the same to any pressure desired.

Self-closing faucets are used except at bath tubs and sinks. All fixtures are fitted up in the most approved, open style All wash stands in state-rooms are of the best imported earthenware and were made especially for the steamer. They are supported on nickel plated brass brackets. All faucets, trimmings, non-return valves, pipes, etc., are of brass, nickel plated. Wash stands in lavatories are supported on offset brass legs. The marble tops are deeply countersunk and fitted with aprons of marble. Bath tubs are of the most approved pattern and are all porcelain lined with porcelain rims. Wood work is dispensed with on all fixtures, except for the seats of the water closets, which are of mahogany and quartered oak. The water closets are of the wash-out pattern, supplied from a pressure tank, and are so constructed that all pulls, chains, etc., are dispensed with. The use of the closets insures their being flushed, and under no conditions can they be left to run constantly. The closet tanks are made of heavy copper, nickel plated, in all cases except for crew, where they are planished copper. The floor of the gents' lavatory on the spar deck is laid in choice Tennessee marble tiling with marble base, etc., and has a three-stall Cataract urinal fitted up in marble with the partitions and backs made of heavy white plate glass, while the floor walls and partitions of the gents lavatory on main deck are all of Tennessee marble, and both are supplied from flushing tanks. Fixtures for the officers are the same as for the passengers. The fixtures for crew, firemen, cooks and waiters are also the same as for the passengers, except that where the latter are nickel plated, the former are in finished brass, copper, etc., and the washstands are of iron, galvanized or enameled. Waste water from all fixtures is discharged overboard. Each fixture is fitted with a non-return valve, and all waste and soil pipes are well ventilated. Hose valves of 1½ inches, with hose attached, are placed at convenient points to guard against fire, to wash decks, and for other purposes. The steamer is fitted with a large fresh water storage tank, from which the water supply is taken, when in port. Provision is made for filling this tank from city water works while in port, and also for drawing direct from the lake when out of port. Exhaust steam from the steam pump that operates the plant is used to heat water for the hot water system. All machinery and all fixtures in connection with the apparatus are self-contained. There are no floats, levers or weights to get out of order. The non-return valves are rubber ball valves, or aluminum, except in a few cases where brass was preferable.

The steam heating system extends to all the cabins and staterooms, to the smoking room on the hurricane deck, pilot house and captain's cabin in the texas, cabins and state rooms on spar-deck, dining saloon, vestibule and offices, bar and cafe, and petty officers' quarters on main deck. Steam is also supplied for operating coffee and water urns in the saloon dining room, and officers mess, and for steam kettles, vegetable steamers, dish washing machine, steam carving table, plate warmers, etc., in the saloon galley. All steam heating pipes are concealed on the three principal decks of the vessel, and are arranged to follow a channel made for them at the combing, where the wood work is protected by asbestos and galvenized iron shields, and covered with open work metal screens. The steam is supplied at a reduced pressure, and all condensed water is drained from the system automatically. This plant was designed by Col. Smith, sanitary heating and ventilating engineer of Cleveland, O., and put in by Smith & Connors of Cleveland.

Concerns Represented in the North West.

No expense was spared in obtaining for all parts of this vessel the best material, best auxiliary machinery, etc., and it is, therefore, a compliment to any concern to be included among the list of firms that assisted in her equipment. Firms having direct charge of extensive portions of the work are mentioned in the general description of the ship, and below will be found the names of nearly all other concerns that had to do with the ship in any way. It will be noticed that a large number of them advertise in the MARINE REVIEW, and while there is no definite significance in this, it is a fact that the REVIEW has been selected, exclusively, to give out technical information regarding this magnificent steamer. Following is the list:

Otis Steel Co., Lim., Cleveland, O., plate.
Pencoyd Iron Works, Philadelphia, Pa., beams.
Penn Steel Casting & Machine Co., Chester, Pa., steel castings.
Cleveland City Forge & Iron Co., Cleveland, O., shafting.
Syracuse Tube Co., Syracuse, N. Y., boiler tubes.
Bourne & Knowles Mfg. Co., Cleveland, O., rivets.
The John Van Range Company, Cincinnati, O., cooking outfit.
The Upson-Walton Co., Cleveland, O., ship chandlery.
Randolph & Clowes, Waterbury, Conn., seamless copper tubes.
De la Vergne Refrigerating Machine Co., New York, N. Y., refrigerating plant.
B. F. Sturtevant Co., Boston, Mass., blowers.
Chadburn & Son, 11 Waterloo Road, Liverpool, England, telegraph and signal aparatus.
Geo. F. Blake Mfg. Co., New York, N. Y. pumps.
Columbian Steam Pump Co., Chicago, Ill., ash pumps.
H. R. Worthington, New York, sanitary and refrigerating pumps.
Hughes Steam Pump Co., Cleveland, O., ballast pumps.
Edson Mfg. Co., Boston, Mass., hand steering gear.
E. S. Ritchie & Son, Brookline, Boston, Mass., compasses.
Lawton Bros. & Pratt, Brightwood, Mass., anchors.
L. J. Mattison & Co., Cleveland, O., paints and oils.
United States Metallic Packing Co., Philadalphia, Pa., packing.
Viaduct Brass Works, Cleveland, O., deadlights, etc.
The Martin-Barris Co., Cleveland, O., wood for cabin finishing.
Purdy & McNeil Lumber Co., Cleveland, O., soft wood timber.
Pittsburgh White Metal Co., Pittsburgh, Pa., babbitt metal.
Merchant & Co., Philadelphia, Pa., bearing metal.
Stowe, Fuller & Co., Cleveland, O., fire-brick for boilers.
Gleason & Bailey Mfg. Co., Seneca Falls, N. Y., hand pumps.
P. Hayden S-H Co., Columbus, O., anchor chain.
The Adams & Westlake Co., Chicago, hardware.
Colby & Son, Chicago, Ill., upholstery.
Chicago Carpet Company, Chicago, Ill., carpets.
Gutta Percha Rubber Manufacturing Co., New York, tiling.

We are indebted to a number of these firms, notably the Martin-Barris Company, Cleveland, O., and Adams & Westlake, Chicago, Ill., for information entering into the description of the ship.

Odd Facts and Figures.

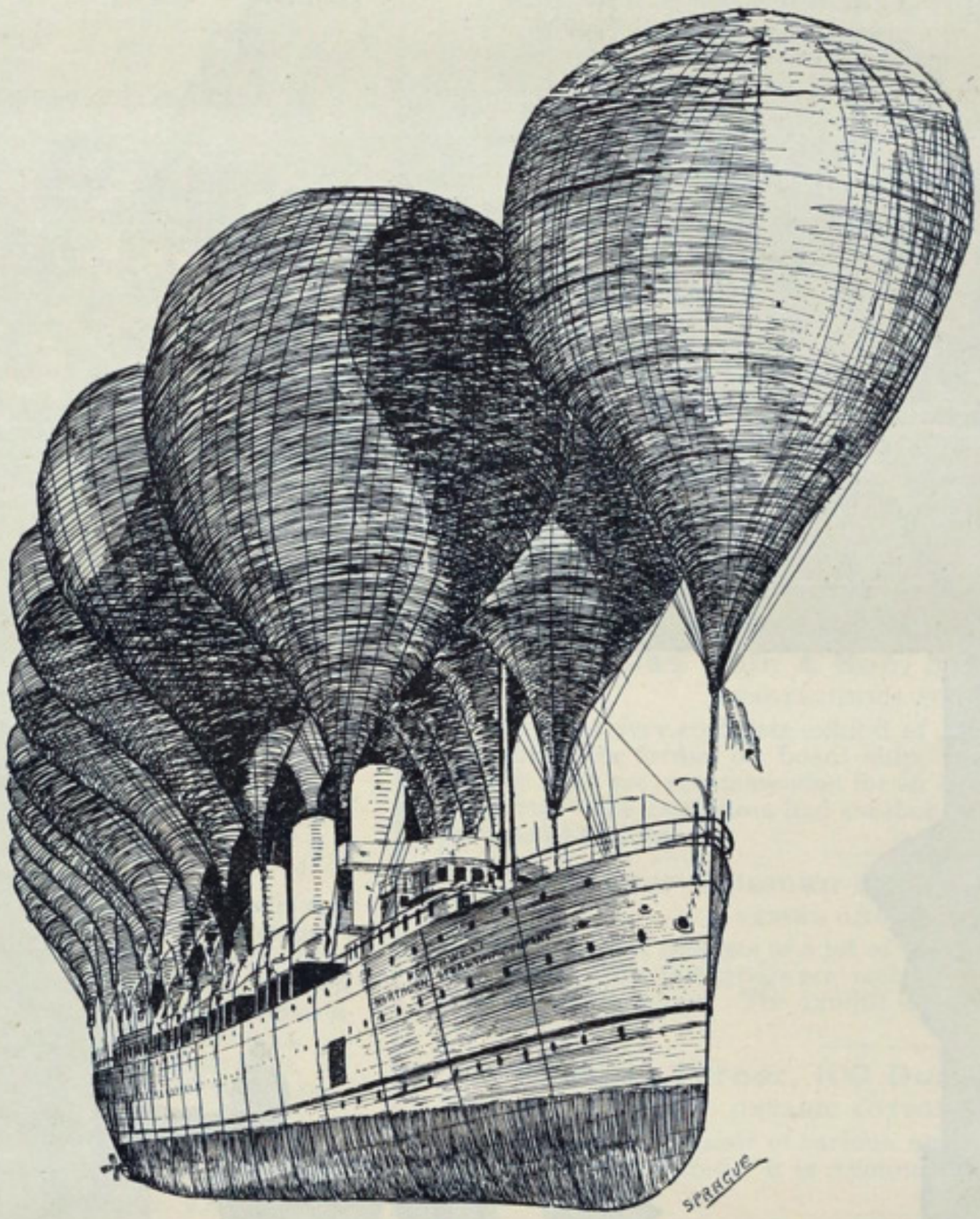
COMPARISONS AND CALCULATIONS TENDING TOWARD A COMPREHENSIVE VIEW OF THE SIZE AND POWER OF A SHIP LIKE THE NORTH WEST.

In a steamship a third larger than one is accustomed to seeing on the lakes, having two screws, and fully four times as much power as the most powerful, and costing from three to four times as much as the most costly there are a great many things that can not be appreciated by the figures in themselves, but which when compared with something ordinary, will be

more readily comprehended. In order that the great stride in lake ship building represented by the North West may be understood, some interesting though not technical comparisons are made. An idea of the immense area of the hull may be obtained from the fact that the larger portion of fifteen tons of paint and thirty barrels of oil were used in coating its surface, the minor part of this immense quantity of fluid being used on the cabins. The body is of one coat of red, and over this there are six or seven coats of white.

Then, if it is considered that the largest steel ore carrier on the lakes, loaded with ore to 16 feet draft, does not weigh as much as the North West with fuel aboard, something of the massive construction and weight of material can be understood. With fuel aboard, engines, etc., all complete, the steamship weighs 4,560 tons.

As considerable scientific research is now directed toward the possibility of aerial navigation, an illustration is shown herewith, of the North West several hundred feet above her native element. The artist has shown as many baloons as the space would permit, but 814 baloons, each containing 18,312 cubic yards of gas, having a density 0.410 of that of air, would be required to raise the steamship. In this calculation allowance is made for the baloon envelopes and tackle weighing 8,800 pounds in each case. A baloon of this capacity would be 260½ feet long by 57½ feet diameter, as is the baloon soon to be put in operation at the Antwerp exposition, and which is to be propelled by electricity, the force being applied through a 27¼-foot propeller.



FROM A CALCULATION IN AERIAL NAVIGATION.

In considering the North West's weight it must be remembered also that she has, corresponding with her weight great power, which may be illustrated by the fact that if chains could be rigged to her shaft and fastened to a draw-bridge 100 feet above, the North West would, strains on the ship permitting, lift herself up to it by her own power in about four minutes.

The engines that develop the aggregate of 7,000 horse power necessary to propel her at full speed are ponderous and wonderful, and yet so well designed that they work like a watch. There is more truth than poetry in this statement. An engineer who said the engines worked like a sewing machine thought he was paying them a compliment, but in reality it was slander. A watch furnishes a much better comparison. A watch ticks 120 times a minute. When running full speed the engines of the North West turn their tons of cranks and shafting around that many times a minute, and the eight pistons in the cylinders are traveling up and down at a speed of 840 feet per minute.

Steam enters the high pressure cylinder at the rate of 2,040 cubic feet per minute and leaves the low pressure cylinder at the rate of 17,748 cubic feet per minute. Steam is worked pretty hard by this quadruple expansion process. It is fixed so that it does as much work in the last cylinder as it does in the first. It would seem that it ought to go through the engine opposite to what it does, and be compressed instead of expanded, but the less pressure the more room is required for it to do its work.

Every time the engines turn over and give the 13-foot propeller wheels a revolution, they send the boat 18 feet ahead—at least 18 feet is the pitch of the propeller, and while there is some slip it does not amount to half a foot. The sizes of the four cylinders on each engine are 25, 36, 51½ and 74 inches by 42 inches, the cubical contents of the eight cylinders being equal to a room about 7 by 7 by 8 feet.

And yet within this space work is being done all the time that would require the nominal strength of 7,000 horses. Very wonderful! But all this power comes in the shape of steam through two 1¼-inch holes, which are in the separator in the main steam pipes, between the boilers and the engines. This steam is generated by twenty-eight Belleville water tube boilers. In these boilers are 4,032 tubes, having a combined length of 21,406 feet or about four and a half miles. The cubical contents of the tubes is 1,533 cubic feet, or, the inside space of the tubes in which water is turned into steam, would make a room 10 by 10 by 15 feet, and the fire spaces in all the boilers, which makes steam of water in the tubes mentioned, would if put together make a surface 28 by 29 feet.

A summary of the power-producing paraphernalia in the North West would be a room 28 by 29 feet, with a fire all over the floor, heating water in a room 10 by 10 by 15 feet, into steam at 250 to 300 pounds pressure, which in turn does its work of churning the pistons up and down in a roon 7 by 7 by 8 feet.

The most marvelous feature, however, connected with the power of the North West is her water consumption. Through her twenty-eight boilers she drinks up seventy tons of water per hour. This is equal to 2,240 cubic feet of water, or the contents of a tank 10 feet wide by 25 feet long by 9 feet deep. This is for only one hour. Her running time on a round trip from Buffalo to Duluth is 120 hours. Therefore, on a round trip this boat would use up a quarter mile section of a river having a depth of 9 feet and a width of 25 feet.

EXTRA COPIES OF THIS ISSUE OF THE REVIEW CONTAINING ALL SUPPLEMENTS WILL BE MAILED TO ANY ADDRESS UPON RECEIPT OF 50 CENTS IN STAMPS.

AN EXTRA COPY OF THE PHOTO-GRAVURE SUPPLEMENT OF DIRECTORS OF THE LAKE CARRIERS' ASSOCIATION, TOGETHER WITH THE LARGE ENGRAVING OF THE STEAMER NORTH WEST, BOTH OF WHICH ARE CONTAINED IN THIS ISSUE, WILL BE MAILED IN A PASTEBOARD TUBE TO ANY ADDRESS UPON RECEIPT OF 50 CENTS IN STAMPS.

AWARDS FOR MARINE EXHIBITS AT THE WORLD'S COLUMBIAN EXPOSITION.

Although the World's Fair has passed into history, considerable interest attaches to the awards made by committees on the different exhibits, as they have not as yet been made public. The REVIEW has had this information in hand for some time, and now has the permission of the chief of the department of transportation, Mr. Willard A. Smith, to use them. He says in a recent letter:

"According to the best of my information it will be many months before the medals and diplomas are issued. The only difficulty connected with your publishing the awards as you have them is that the wording may be somewhat changed in the final revision. The awards themselves can not be changed."

The illustration herewith gives a correct idea of the general design of the diploma to be awarded to exhibitors. The plate was made from a photograph of the original drawing by the artist, Will H. Low, and is considerably smaller than the diploma itself, the size of that document being 18 by 24 inches. It will be printed upon the finest Japanese paper in black ink and will be in every way a triumph of the designers' and engravers' art. The central idea of the design is that of crowning the new world with the laurel wreath. The lower portion shows a barge of ancient pattern with shields of the different countries at its side, propelled by representatives of different nations, with Columbus at the helm. Under the arch at the top is a perspective view of the World's Columbian Exposition from Lake Michigan. The arts and sciences are symbolized by single figures at the extreme upper corners, and at the base of the arch are children of the aborigines receiving instruction, the figure imparting same reclining against a kneeling American bison. The bearer of the laurel reaches gracefully toward the object of her attention at the left. The names of the countries of the old and new world exhibiting at the fair are inscribed on scrolls at the right and left of the center space, which is reserved for lettering by the judges of award.

Wilcox, Crittenden & Co., Middletown, Conn.

MARINE HARDWARE.

This exhibit is a large and well arranged assortment of marine hardware. All of it is of good, some of first rate quality and workmanship, and some are objects of new and practical construction. Therefore it is recommended for an award.

BARANDON.

American Ship Windlass Company, Providence, R. I

PROVIDENCE NEW STYLE STEAM CAPSTAN WINDLASS—DOCK STEAM WINDLASS—STEAM TOWING NACHINE—PROVIDENCE BAR AND CRANK CAPSTAN—PROVIDENCE NOISELESS PUMP BRAKE YACHT WINDLASS—PROVIDENCE PUMP BRAKE FRICTION GYPSEY WINDLASS.

This exhibit consists of Providence new style steam capstan windlass, dock steam capstan, steam towing machine, Providence bar and crank capstans, Providence noiseless pump brake yacht windlass and Providence pump brake friction gypsey windlass. The first excels in compactness, strength, durability, ease of manipulation, lightness and reliability. Its good qualities are attested by its use in fourteen of the newest vessels in the United States navy. The second is a modification of the first, where the motor engine is on a level with the base of the capstan, instead of underneath. It excels in having the cutting of the worm wheel arranged to insure contact over the whole surface of the bearing faces, securing smooth running.

The steam towing machine is a very ingenious engine, excellent in design and workmanship. It is for use on board tug boats, especially intended for towing heavily loaded barges in rough seas.

The bar and crank capstans are a lot of very handy and powerful capstans for vessels carrying small crews. In point of workmanship and design they have nothing to be desired. The noiseless pump brake yacht windlass excels in being light, noiseless, compact and powerful, possessing extremely simple and effective locking gear. The pump brake friction gypsey windlass is a simpler and less expensive modification of the above, of good workmanship and adaptability. All are recommended for an award.

CAPT. MERTIAGO.

Gas Engine and Power Company, Morris Heights, N.Y.

NAPHTHA LAUNCHES.

This exhibit consists of a number of handsome naphtha launches, and an award is recommended for the only engine operated by spirits of petroleum expansively for power, giving greater power for cylinder volume than any other motor, and maintaining constant pressure at all times, the action being automatic, being the only engine supplied from a boiler or retort from which fuel is taken, and which utilizes a liquid which volatilizes at a low temperature and condenses at a moderate temperature, expending a minimum of heat. No explosion is possible, for when the supply to boiler stops the fire goes out, and when the fire is extinguished the supply of naphtha ceases. It is the only engine that will take up its own wear, having a universal motion of shaft for each revolution; instantaneous reversing mechanism, economical and simple with few working parts. Weight of engine for horse power is only about one-half that of the steam engine, and boiler, engine and lamps being practically one piece, it occupies but little space, which permits of its location in the stern, thereby giving undivided and increased passenger accommodation. That there has never been an explosion of one of these boilers, and few serious accidents, and those due to serious carelessness, shows how well this explosive liquid is controlled. The hulls are excellent in all respects. R. M. BERRY.

Detroit Boat Works, Detroit, Mich.

ROW BOATS, CANVAS LINED, AND 20-FOOT SAIL BOAT.

The row boat is well finished in very thin wood, and canvas lined inside. The sail boat is well finished and well disposed with double cat sails.

V. M. CONCAS.

METALLIC LIFE RAFT AND METALLIC LIFE BOAT.

The raft is very simple and solid in construction. The life boat is very well finished, double riveted, with two air tanks which are very convenient, especially in metallic boats; the form is that usually found on board ships. An award for good designs and very good workmanship in their metallic and wooden boats and rafts, and the hulls of the electric launches is recommended.

V. M. CONCAS,
D. MERTIAGO,
FRANCIS ELGAR.

Thos. Drein & Son, Wilmington, Del.

METALLIC LIFE RAFT FOR PASSENGER STEAMERS.

This exhibit is a good specimen of a life raft. Its buoyancy is furnished by two cylinders, one on each side, which are sub-divided into separate air tight compartments. The platform is elevated well above the water, and altogether they appear to be a buoyant, useful and safe form of raft. Recommended for an award for its buoyancy and suitability for use as a life saving raft in ships.

FRANCIS ELGAR.

CORK LIFE PRESERVERS AND RING BUOYS.

This exhibit presents productions intended to sustain great wear and strain of long service on board trading ships; and, as they are approved for use of the the United States board of inspectors, and extensively used on account of their comparative cheapness, an award is recommended.

CAPT. D. MERTIAGO.

Boston and Lockport Block Company, Boston, Mass.

HOLLOW STEEL BLOCKS — DIFFERENTIAL TACKLE — BOSTON PATTERN SNATCH BLOCK—CARGO HOISTING BLOCK—METALLIC BUSHINGS—FIVE ROLLER PATENT BUSHINGS—FRICTIONLESS IRON NON-CHOKABLE PUMP, AND YACHT AND VESSEL SUPPLIES.

The steel blocks of different sizes are all of neat finish, solid fastening and first rate workmanship. The differential blocks are of great power and of easy manipulation, and the workmanship and finish leaves nothing to be desired. The same superior quality of workmanship which is so excellent, prevails throughout each individual exhibit and entitles the collection as a whole to an award.

CAPT. D. MERTIAGO.

Continental Iron Works, Brooklyn, N. Y.

STEEL FURNACES FOR MARINE BOILERS.

This exhibit consists of large specimens of the well known and extensively used corrugated steel furnaces for marine boilers, submitted for award for excellence of manufacture and efficiency for use in marine boilers.

FRANCIS ELGAR.

The Globe Iron Works Company, Cleveland, O.

STEAM STEERING ENGINES.

The combined steam and hand steering engine is of excellent design and manufacture. For compactness and simplicity and the readiness with which it can be worked is worthy of award.

FRANCIS ELGAR.

STEAM CAPSTAN, WINDLASS AND STEAM CAPSTAN ENGINE.

They possess many excellent qualities. Excellent workmanship and fine finish materially add to the worthiness of the appliances.

CAPT. D. MERTIAGO.

Safety Car Heating and Lighting Co., New York, N. Y.

GAS LIGHTED BUOYS.

This exhibit consists of two full sized steel buoys of very good construction and workmanship. The experience of many years in various countries has shown that these buoys have ample buoyancy; that they burn continually a number of days which can be exactly predetermined; that the flame is not extinguishable either by the wind or action of the waves breaking over them in a gale; that the quality of the gas employed is excellent, and that the apparatus for regulating the gas pressure of the burners is sufficiently good. Taking all this into consideration, this exhibit is recommended for an award.

CAPT. D. MERTIAGO.

Washburn & Moen Mfg. Company, Worcester, Mass.

STEEL HAWSERS, STEEL ROPES AND GALVANIZED WIRE AND WIRE ROPES FOR SHIPS RIGGING.

This exhibit consists of wire rope suitable for tow lines, standing rigging, tiller ropes, etc. An award is recommended for general excellence, including great tensile strength, pliability and good galvanizing. The wire for tiller ropes is especially pliable.

R. M. BERRY.

Chas. F. Elmes, Fulton and Morgan Sts., Chicago, Ill.

STEAM LAUNCH CHICAGO.

This exhibit formed one of a fleet of small steamers plying between the grand basin, south lagoon, of the World's Fair and Lake Michigan for the transportation and amusement of visitors. The high standard of efficiency of this launch is well known. It is, therefore, recommended for an award.

CAPT. MERTIAGO.

U. S. Metallic Packing Company, Philadelphia, Pa.

METALLIC PACKING FOR MARINE ENGINES.

This exhibit shows a good system of metallic packing for marine engines which has been in successful use for several years in a large number of steamers. Recommended for award on account of efficiency, reduction of friction and non-liability to get out of order with proper use.

FRANCIS ELGAR.

Jas. Pain & Son, New York, N. Y.

PYROTECHNICS FOR SHIPS' USE.

This is a very complete exhibit of rockets, blue lights and boxes for containing the former on board ship, ready for long distance signaling. Pain & Sons are recommended for an award for the good quality of their products. The exhibitors had another exhibit in the British section, Manufacturers building.

V. N. CONCAS.

Walter Coleman & Son, Providcnce, R. I.

VESSEL AND YACHT BLOCKS.

This exhibit consists of a lot of vessel blocks very neatly made and of fine finish. The fastenings are solidly made by means of brass screws clinched at the point. The exhibit is recommended for an award.

CAPT. D. MERTIAGO.

J. Spencer Turner, 109 Duane St., New York, N. Y.

ONTARIO COTTON SAIL DUCK.

This exhibit consists of various qualities of cotton sail duck, strong and well manufactured. It is recommended for an award.

N. MARTIUS DE TOLEDO.

R. Merrill's Sons, New York, N. Y.

LOG, COMPASS AND BINACLES.

They are constructed on the best principles for the required purposes; are made of good material and the work is very well finished.

J. MARTIN DE TOLEDO.

Cape Ann Anchor Works, Gloucester, Mass.

ANCHORS.

This exhibit consists of different sizes and patterns of small anchors for boats and yachts. They show nothing special in pattern, but the work is strong and well done. It is, therefore, recommended for an award.

J. MARTIN DE TOLEDO.

C. K. Williams & Co., Easton, Pa.

ALLIGATOR ANCHOR.

This exhibit is an anchor with double movable fluke, with a large crown in the center. It has been adopted in some of the American men-of-war, and is considered one of the best modern anchors of that type.

V. N. CONCAS.

DeGrauw, Aymar & Co., 34-35 South St., New York, N.Y.

OARS.

This exhibit consists of ash oars of first class material, well made, superior pattern and finished workmanship. They are, therefore, recommended for an award.

BARANDON.

McBean, Edge & Co., Buffalo, N. Y.

LENS SIGNALS AND LAMPS.

Made of good material and of very good workmanship.

J. MARTIN DE TOLEDO.

JOHN MITCHELL. JOHN F. WEDOW. ALFRED MITCHELL.

Mitchell & Co., Cleveland, O.

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The entire scheme for the DECORATIONS and FURNISHINGS of the S. S. NORTH WEST were designed by and executed under the personal supervision of

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THE BELLEVILLE NON-EXPLOSIVE BOILERS are now in use in about 40 vessels, exclusive of numerous yachts. Among these are French, English and Russian Naval and Merchant Marine craft, using nearly 250,000 horse-power, and there are now in course of construction in France and England for Naval vessels about 75,000 horse-power. There are in use or building in the United States for Merchant vessels 12,500 horse-power.

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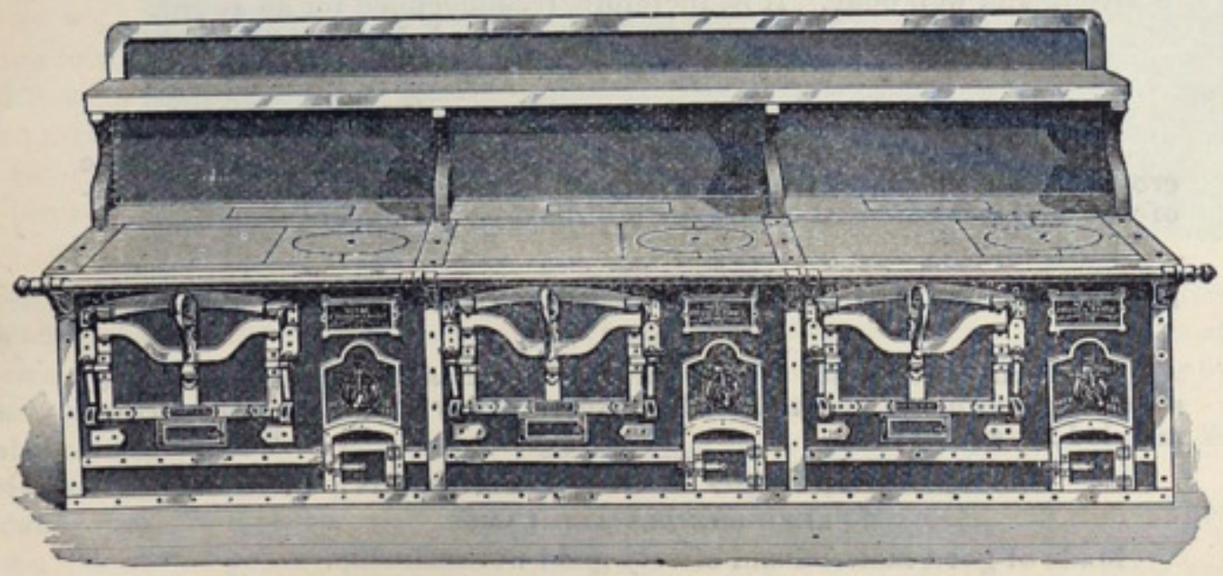
Van's Patent Improved Wrought Steel Portable RANGES



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169 ELM and 4, 6, 8 and 10 HOME STREETS,

Cincinnati, Ohio.

The Complete Cooking Apparatus for the Steamship North West was furnished by this Company.

WATER SUPPLY and SANITARY PLANT of the NORTH WEST.

The system of Hot and Cold Water Appliances and Steam Heating Apparatus of this Steamship, fully described on another page, was supplied by us. A similar plant will be put in the NORTH LAND, second boat of the Passenger Line now under construction.

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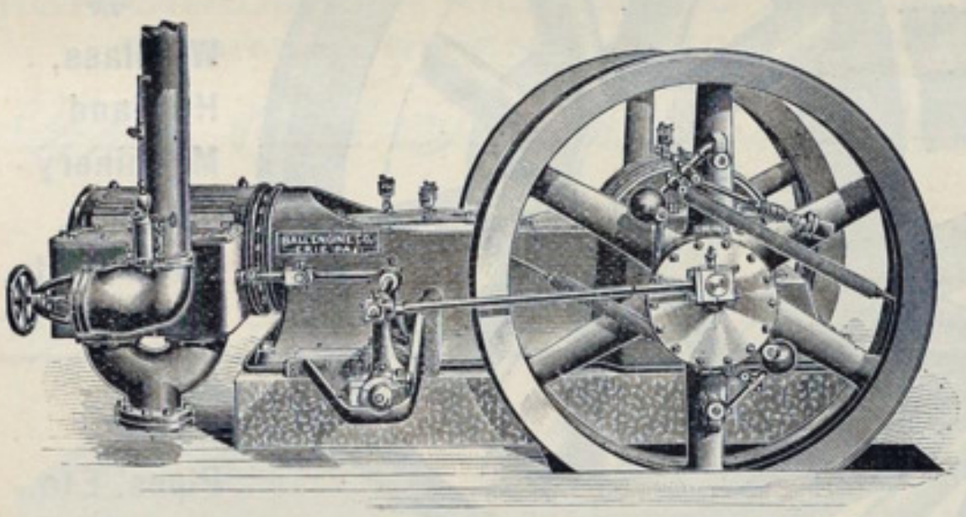

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OUR ENGINES

are running light plants on Steamers: W. H. Gilbert, W. H. Gratwick, City of Chicago, Merida, Curry, Detroit and Cleveland Boats, Centurion, AND OTHERS.

The Yarrow Patent Water Tube Boiler.

HORACE SEE, 1 BROADWAY, N. Y., AMERICAN AGENT.

The factor of weight in boilers for marine service is very important. From information published recently it is learned that Scotch boilers fitted with the Howden system in an 8,000 horse power boat, weighed 361 tons; Belleville boilers in the Polynesien, 8,000 horse power, weigh 380 tons; in the North West, 7,000 horse power, they weigh 362 tons; in a boat with Thornycroft locomotive boilers, 3,500 horse power, the weight was 112 tons; for 4,500 horse power, Thornycroft water tube boilers weighed 92 tons; for H. M. S. Havock, 3,500 horse power, Yarrow locomotive boilers weighed 54 tons; in the Hornet, 4,300 horse power, Yarrow water tube boilers weighed 43 tons, and it is claimed these boilers were unnecessarily large for the power required.

All of the tubes in the Hornet's boilers are of small diameter and straight. Lightness coupled with safety and durability is a prominent feature. They are entirely built out of wrought material. Every part of the boilers is accessible, both inside and out, for examination, cleaning or repairs. The water level is at least ten inches above the top of tubes, whose surface is most effective for heating. The weight of the eight boilers of the Hornet with fittings, water, etc. is 43 tons.

A three hours' trial of the Hornet commenced at the Chapman light-house and ended below the Sunk light-ship. The average speed for the whole time was found to be 27.628 knots per hour. After this, circles at full speed were turned to the starboard and port, and generally all the usual tests of machinery and ship made, all of which were found to be perfectly satisfactory. At full speed and at slower speeds practically no vibration was felt. There was no heating of any parts of the engines, and the boilers made ample steam with a mean air pressure of 1.5 in. The admiralty authorities expressed themselves highly pleased with the result in every respect. A comparison between the results of the Havock and the Hornet shows that in the former on the official trial approximately 3,500 horse power was indicated, as against in the case of the Hornet 4,000 horse power, which approximately, is in direct proportion to the cubes of the speeds of the two boats, the consumption of fuel also being in direct proportion to the powers indicated. The air pressure in the stokeholds of the Havock was about 3 inches, and in the Hornet 1½ inch. A number of destroyers building for the British admiralty by various firms, are being fitted with Yarrow's water tube boilers.

One of the Hornet's boilers weighed complete, with fittings, smoke-box, fire-doors, firebricks, funnel, casings, and all boiler mountings, also including water up to working level, 10,700 pounds. On carefully conducted experiments in the yard it was found that 12,500 pounds of water were evaporated per hour from 60 degrees Fahrenheit to 180 pound pressure. Further particulars and prices will be furnished by Horace See, 1 Broadway, New York, N. Y.

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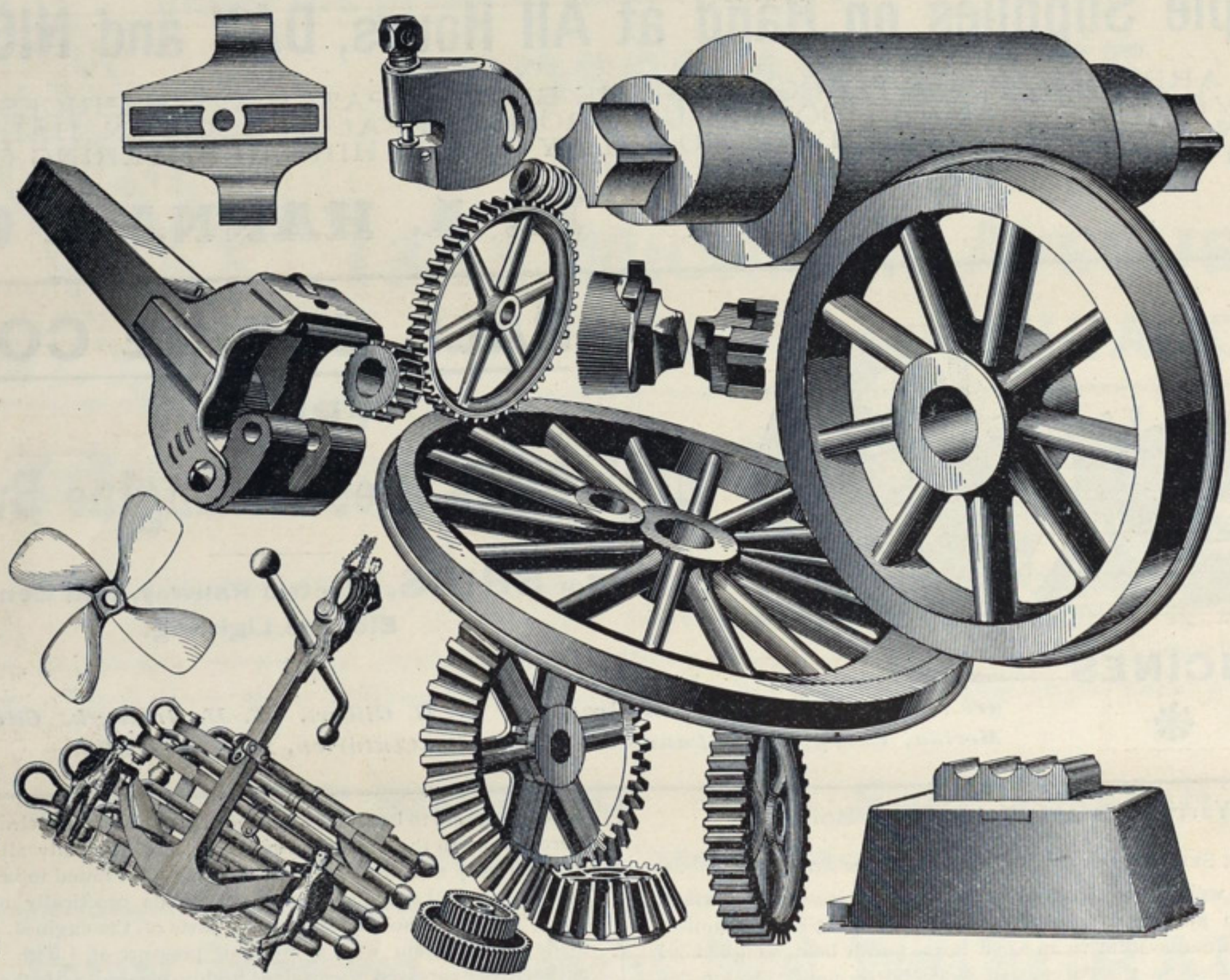

Electrical Castings, Field's Magnets, Pole Pieces, Gears, &c.

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Windlass, Hull and Machinery Castings, Stern Posts, Struts, Stems, Hawse Pipes, Etc.

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STEEL CASTINGS Possessing all the Physical Characteristics of Open Hearth Steel Forgings, having great Tensile Strength and possessing Superior Wearing Qualities:

FROM TEN TO EIGHTY THOUSAND POUNDS WEIGHT.

SPECIAL ATTENTION GIVEN TO LARGE WORK.

ROLLING MILLS, MARINE STATIONERY AND BLOWING ENGINES, STEAM SHOVEL AND DREDGING MACHINERY, STONE CRUSHERS AND BRICK MACHINERY, MINING MACHINERY AND COAL BREAKER CASTINGS, STEAM HAMMERS, ETC., ETC.

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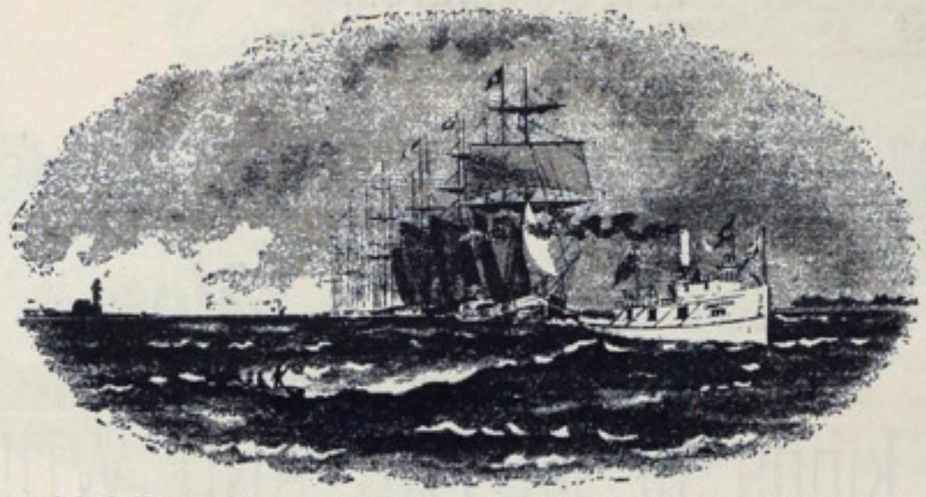
with facilities unsurpassed.



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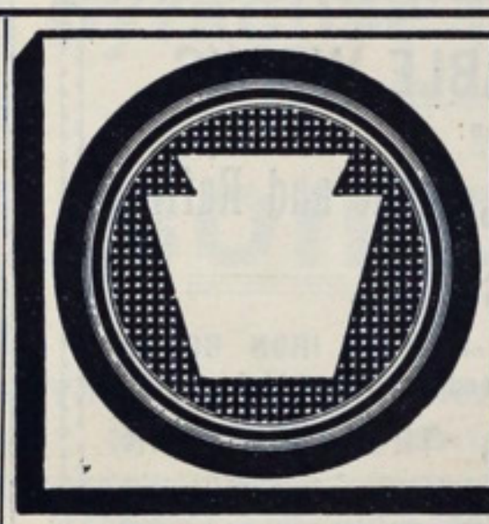

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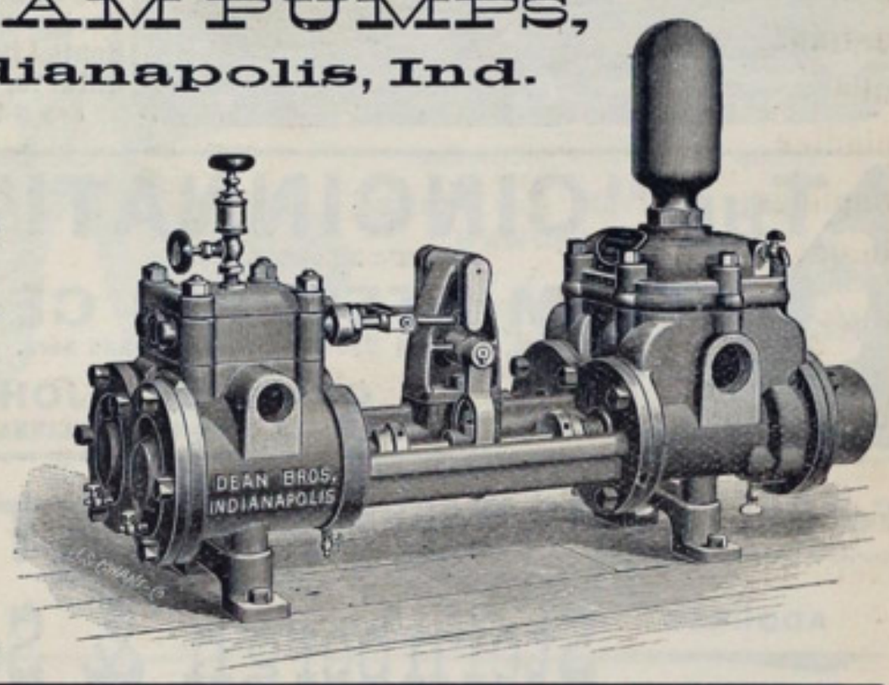

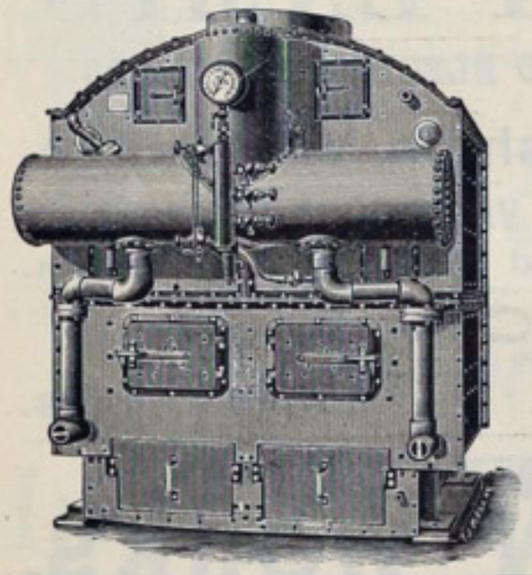

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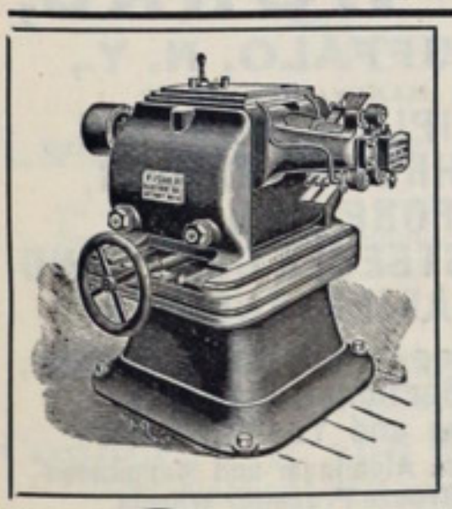

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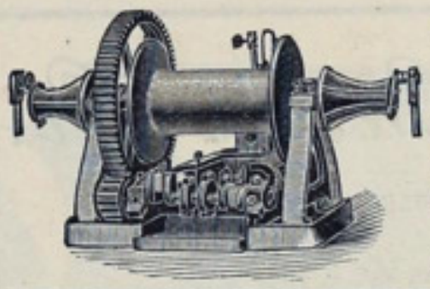

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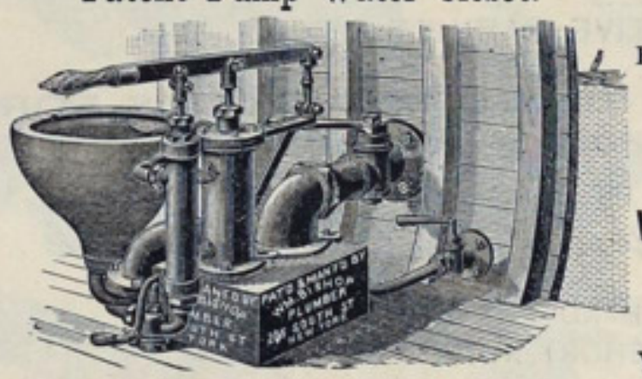

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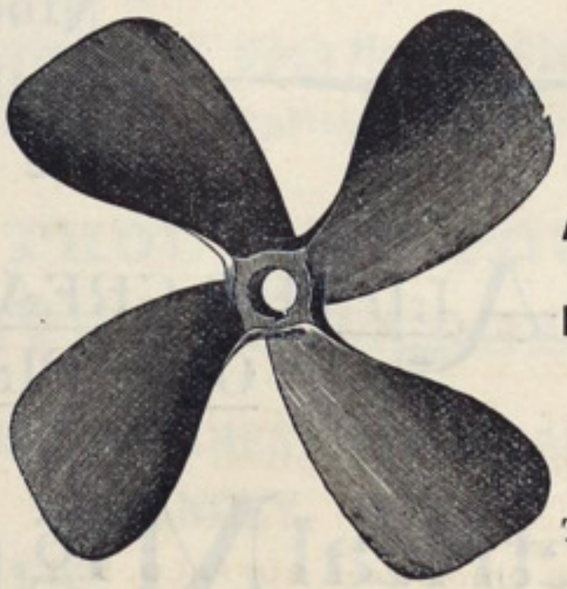

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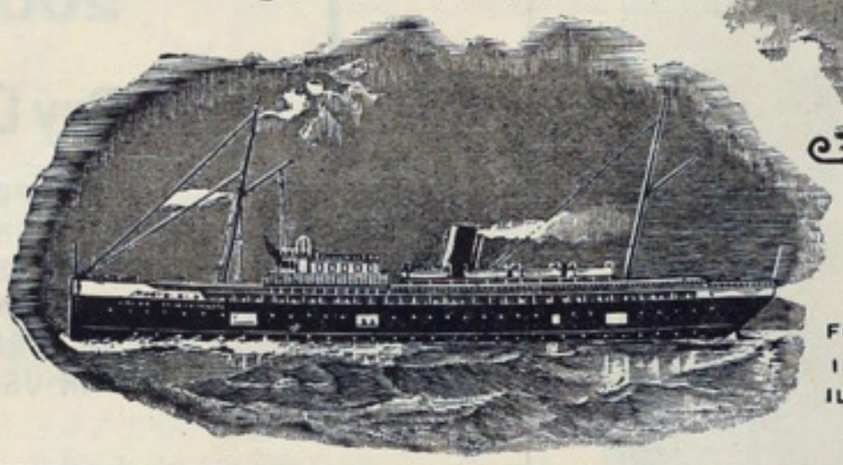

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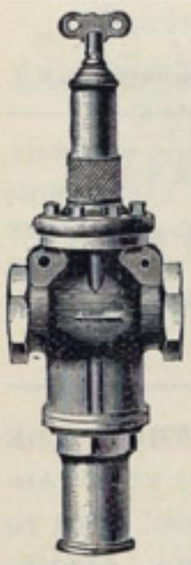

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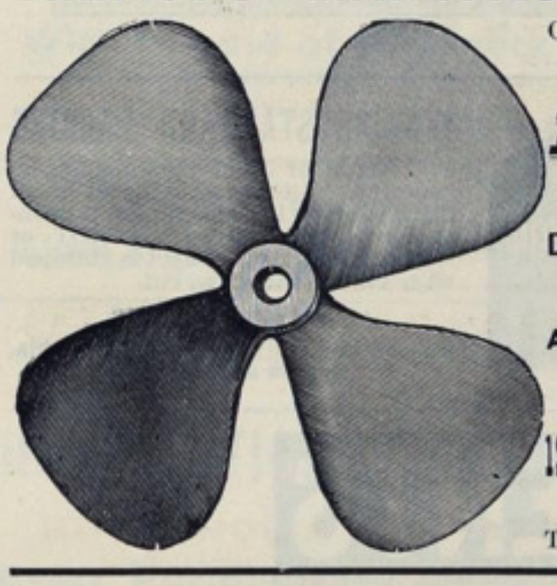

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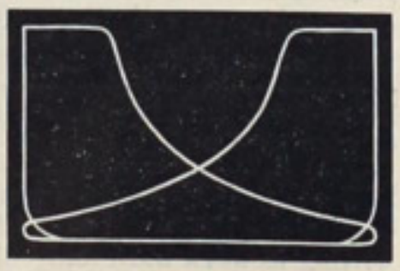

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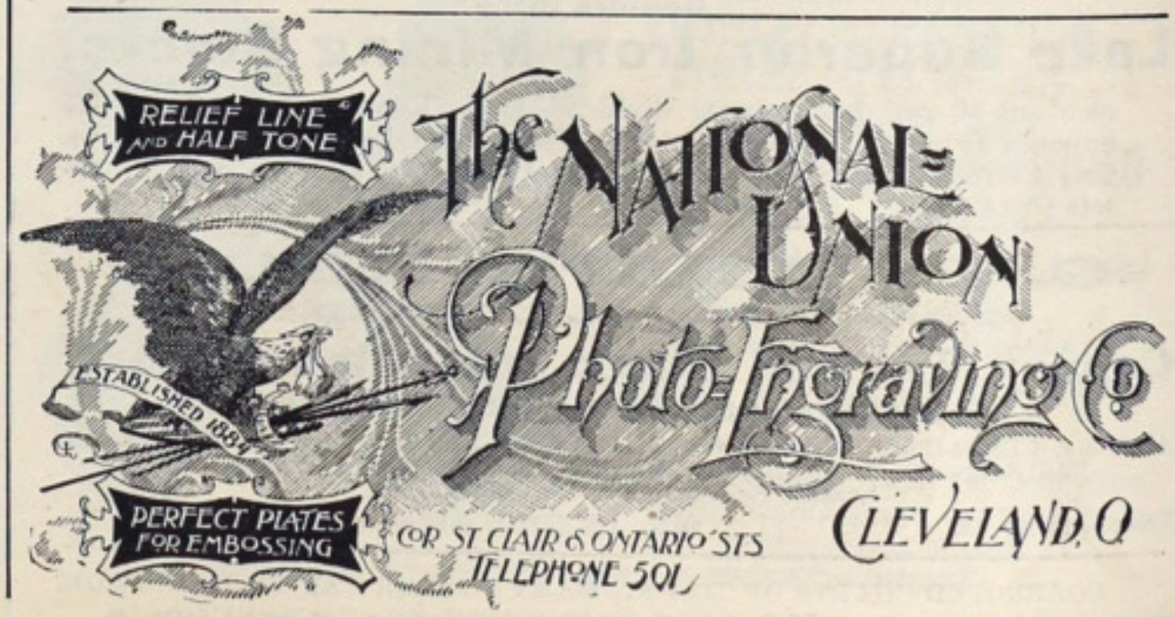

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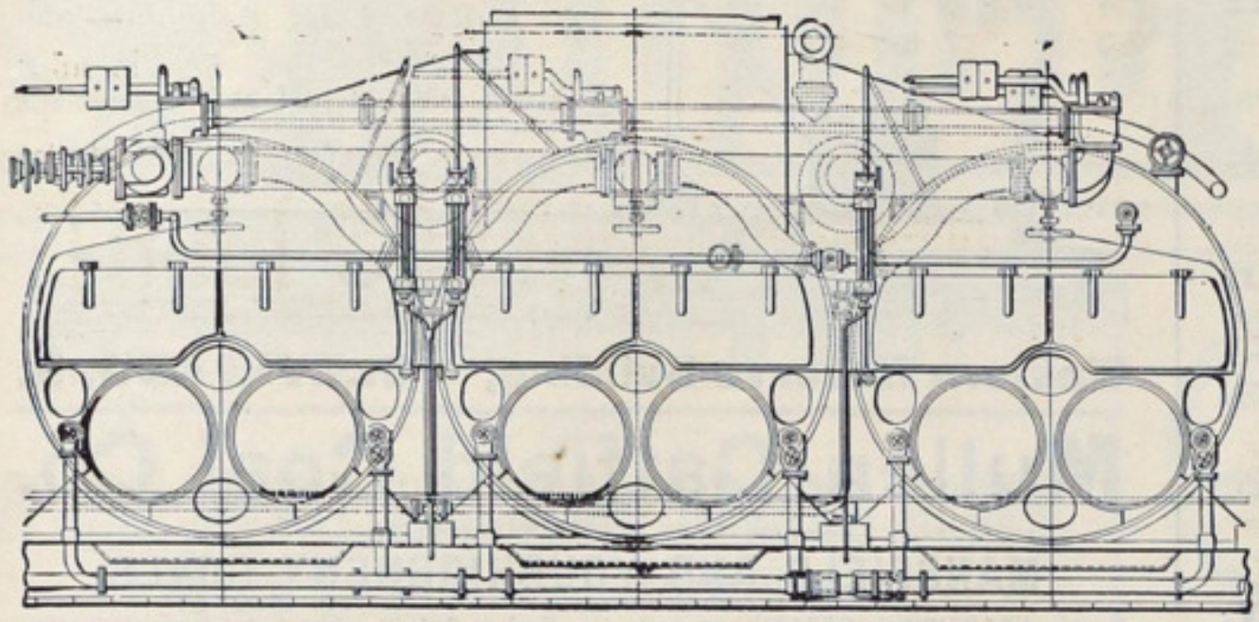

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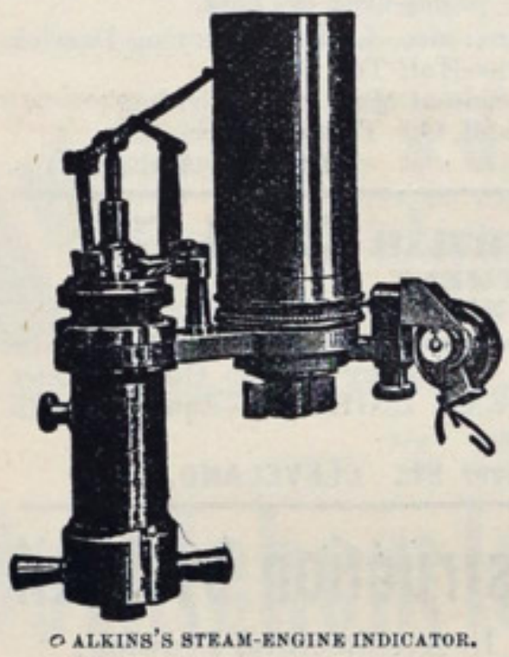

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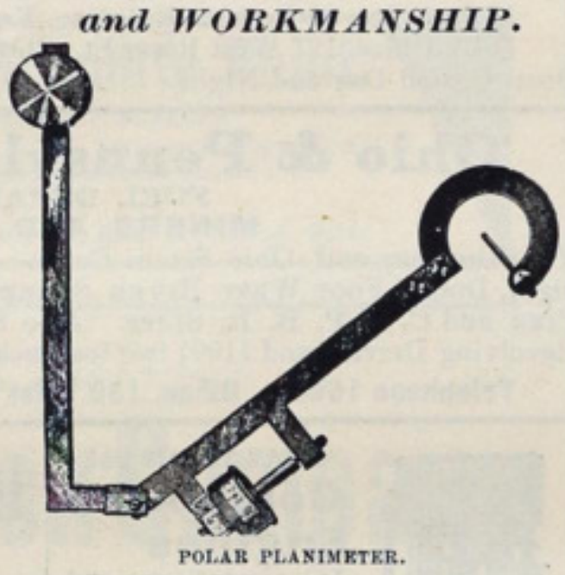

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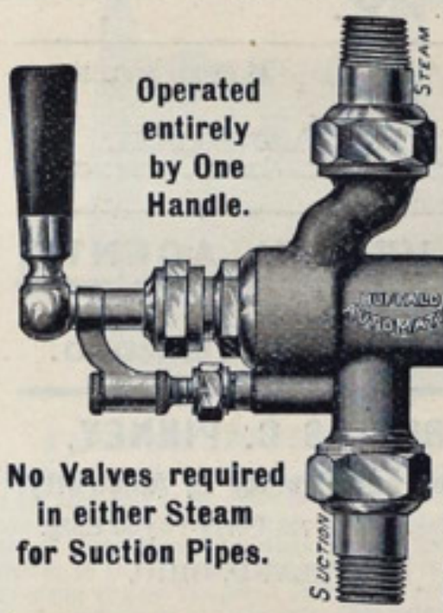

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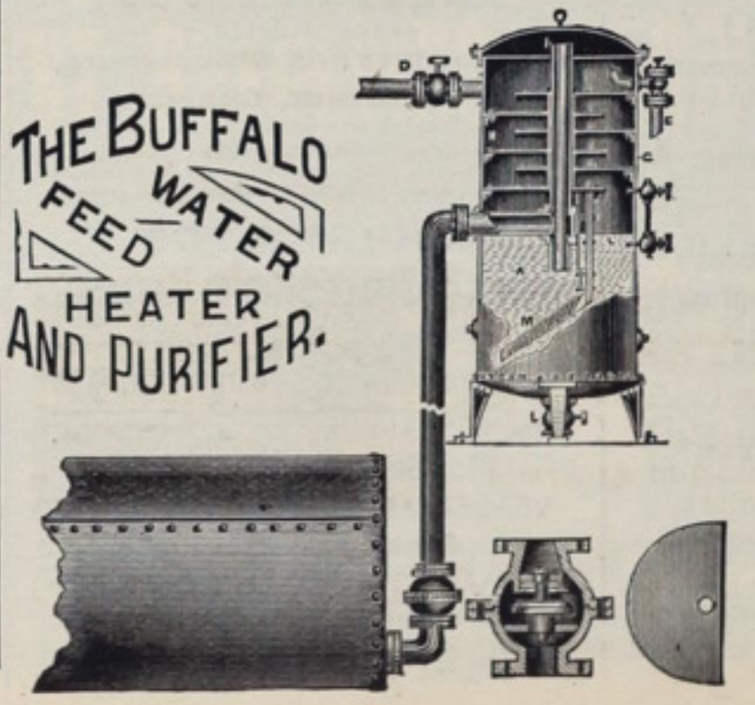

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A.—Settling chamber.
B.—Boiler.
C.—Feed pipe to boiler.
D.—Steam pipe.
E.—Water supply pipe.
F.—Check valve.
G.—Spray disks.
H.—Spray chamber.
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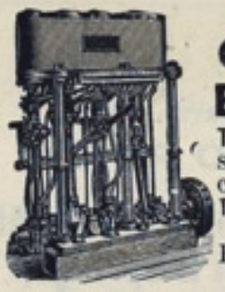

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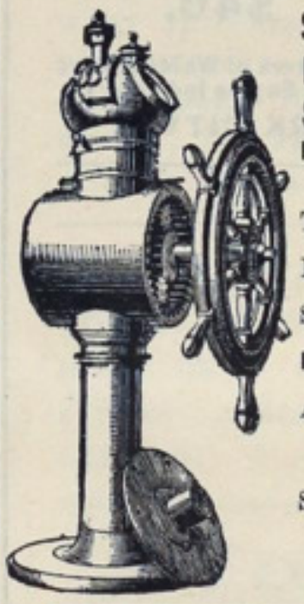

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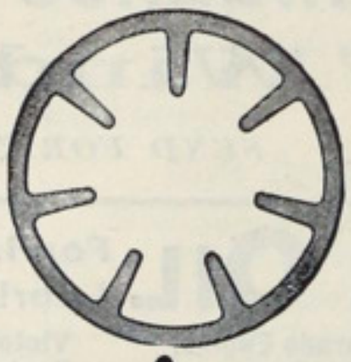

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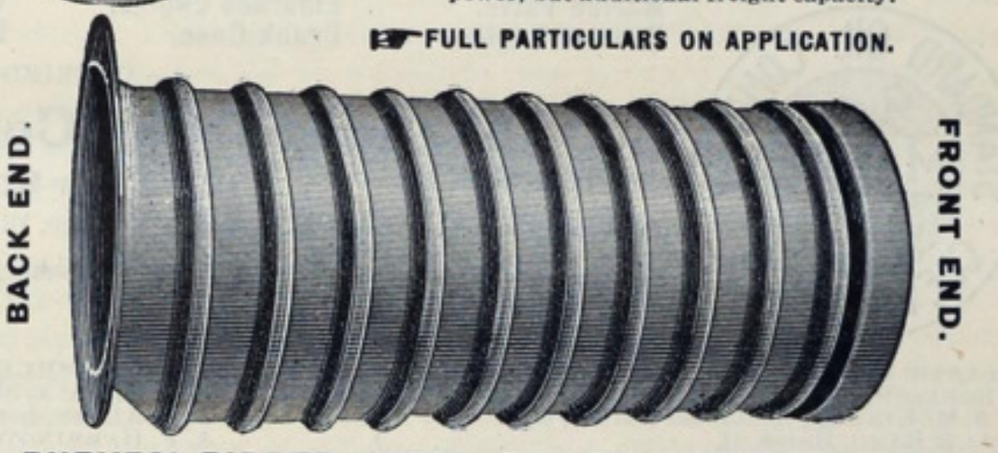

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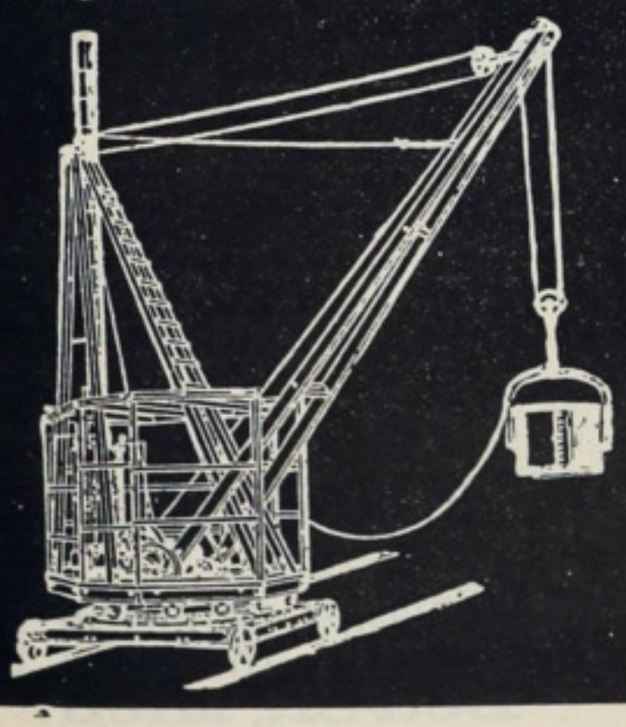

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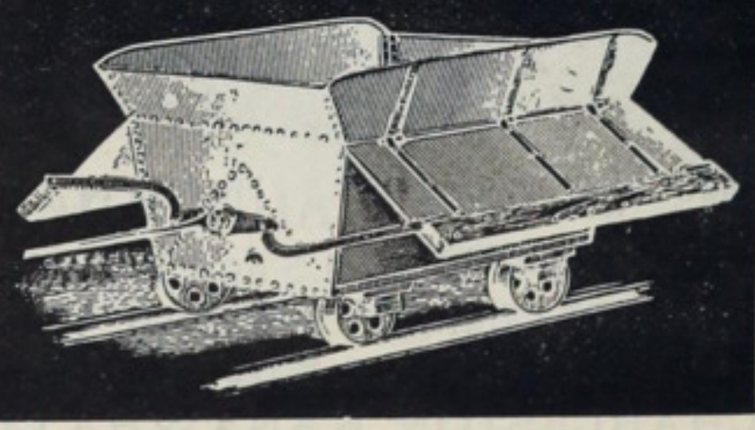

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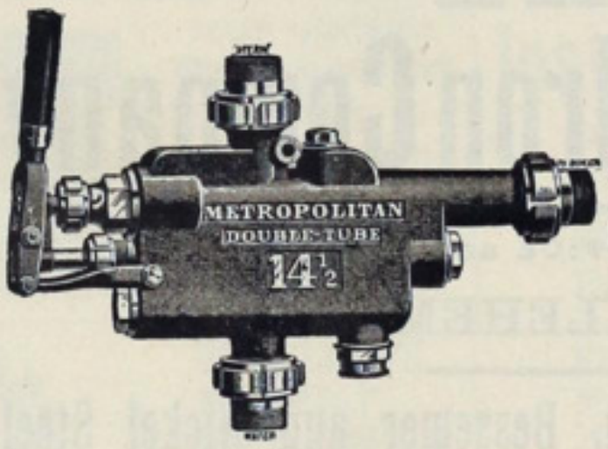

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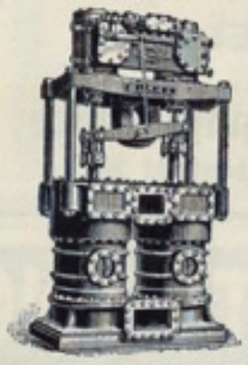

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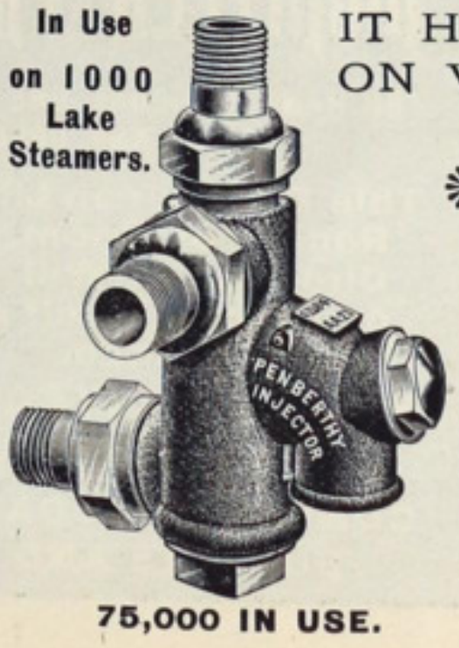

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